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RADIOLOGICAL HEALTH AND SAFETY

A report on the training of radiological health and safety specialists has recently been published (*Training in Radiological Health and Safety: Report of a Committee appointed by the U.K.A.E.A.*, H.M.S.O., 5s. 6d.) by a Committee, under the chairmanship of Sir Douglas Veale (formerly Registrar of the University of Oxford) which was set up to consider the national need for specialists to deal with the health and safety aspects of the use of ionizing radiations and radioactive substances. The report, which makes recommendations about the types of experts needed and their training, is being studied by the U.K. Atomic Energy Authority and the government departments concerned.

The report describes the types of work involved in achieving radiological health and safety, and the kinds of training needed. It reviews the present position in this country and discusses the responsibilities of government departments, local and public authorities, hospitals and the medical profession, and nationalized and private industry. An attempt is made to estimate the total number of trained people required in 1960-70.

Methods of staff training at three levels are considered. At the top level, university postgraduate courses have already been set up to give a wide training—overlapping the boundaries of medicine, biology, physics and chemistry—to selected graduates in science or medicine. There are courses in the universities of London and Birmingham, and the University of Edinburgh is planning a course to begin in October. The Committee believes that these courses, when fully developed, will meet the need for 20-30 top-grade specialists a year.

The report recommends that similar courses of a rather less advanced kind should be set up at two or three colleges of advanced technology. At a somewhat lower level, a scheme is suggested for introducing certificate courses at technical colleges in the autumn of 1961. Such a scheme might be operated by the City and Guilds of London Institute.

The idea of a national training centre is examined, but the Committee considers it unnecessary and recommends that the existing educational system should be adapted to provide the necessary training.

To make the best use of specialists, the Committee recommends that a national radiological advisory service, with regional centres, should be set up under the Minister for Science. This service would give advice to organizations (such as firms making use of radio-isotopes) without full-time health and safety specialists of their own. It would be available to give expert help in the case of an accident involving possible radioactivity hazards. It would also provide such services as processing the film badges worn by all workers who may be exposed to radiation.

The report recommends, too, that all medical students should be given some knowledge of radiological health and safety in their undergraduate training, and that a course should be included in the curriculum for the Diploma in Public Health.

Short residential courses for managers, administrators, medical officers of health and other professional workers are also proposed, as well as books, films, articles, and radio and T.V. programmes for the public.

BRITISH ASSOCIATION

The Annual Meeting of the Association will take place this year in Cardiff from 31 August to 7 September under the Presidency of Sir George Thomson, F.R.S.

Dr James Taylor, M.B.E., is President of Section B—Chemistry, with Dr Bernard Atkinson and Professor W. G. Overend as Secretaries and Dr I. G. Faulkner as Recorder.

The Presidential Address on 31 August is entitled 'The Two Aspects of Science', and Evening Discourses on 'The Structure of the Universe' (2 September) and 'Microbiological Methods in the Development of Drugs' (5 September) will be given by Professor H. Bondi, F.R.S., and Dr E. B. Chain, F.R.S., respectively.

Dr James Taylor's address will be entitled 'Chemistry is Not Enough'.

The Preliminary Programme may be obtained on application to the Association at 18 Adam Street, Adelphi, London, W.C.2.

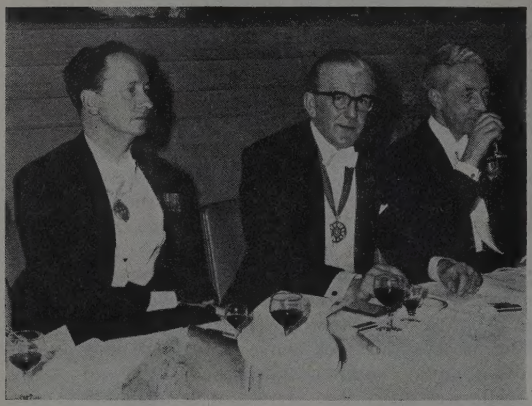
CIBA FOUNDATION

The Report for 1959, recently published, records the successful passing of an important milestone, the 10th anniversary of its formal opening by Sir Henry Dale, O.M., on 22 June, 1949. During that period the Foundation held 58 International Colloquia and Symposia, whose Proceedings have been published in 50 volumes. The most striking new development in 1959 was the holding of three Conferences overseas—in Naples, Paris and Buenos Aires. The year also saw the introduction of one-day International Study Groups, each of which is organized in honour of an overseas member of the Foundation's Scientific Advisory Panel. The five-year period of special encouragement given to research into the fundamental aspects of ageing also came to an end in 1959.

Over the years the Foundation has maintained its absolute independence in the furtherance of its object—the promotion of international co-operation in medical and chemical research.

JOINT ANNUAL MEETINGS, BELFAST, 5—8 APRIL

(for description, *see J.*, May, p. 164)



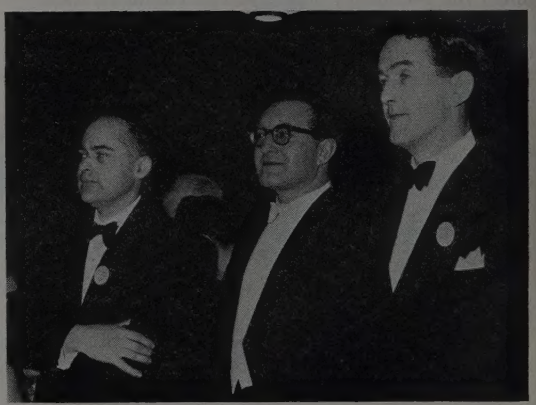
Above (*left to right*). The Lord Mayor of Belfast, with Mr E. Le Q. Herbert, *President*, and Lord Glentoran, Minister of Commerce.

Above (*left to right*). The Mayor of Londonderry and The Mayoress, with Professor and Mrs G. Schwarzenbach

Above. Professor H. J. Emeléus (*left*) and Mr Herbert (*right*)

Below (*left*). Dr M. Grant, Vice-Chancellor, Queen's University of Belfast, with (*right*) Sir Alexander Todd, new President of the Chemical Society

Below (*left to right*). Professor H. B. Henbest (Belfast), Professor R. A. Raphael (Glasgow) and Professor E. R. H. Jones (Oxford)



Below. Professor Harold Burton, Hon. Treasurer, R.I.C.

Above. Professor Charles Kemball (Belfast) receiving the Corday-Morgan Medal and Prize of the Chemical Society from Professor Emeléus, retiring President

Above. Professor C. L. Wilson, Queen's University (*left*) with Dr H. J. T. Ellingham, Secretary and Registrar, R.I.C.

Below. Dr R. J. Magee (Belfast) and Mr D. A. Arnold (R.I.C.) who were largely responsible for the detailed arrangements, with Dr M. Gewing (Belfast), Mr M. C. Hyde (*Chemical Age*); (*extreme left and right*) Mrs R. J. Magee and Mrs M. Magee

Photographs by R. Donnelly, Queen's University, Belfast

TECHNOLOGICAL DEVELOPMENTS, 1960-1965

By SIR HARRY MELVILLE, K.C.B., LL.D., D.SC., F.R.I.C., F.R.S.*

I propose to try to cover this huge field under a number of very general headings and to begin with something fundamental to any industrial country—the supply of energy of various kinds to industry. This country invests many hundreds of millions of pounds a year in the coal, gas and electricity industries alone, and without this nothing in industry would be possible. It is particularly important in this country, where our fuel resource is of only one type, namely coal, to make the best use of what we have and to see also where the limits are. Many unthinking people believe scientists can accomplish miracles, but scientific laws clearly prescribe how far one can go, and it is no use trying to go any further, no matter how much money and effort is available.

EFFICIENT USE OF COAL

As regards coal, it is important to emphasize that the limits of utilization and efficiency have already been reached, both in industry, and even on the domestic side. In very large units such as power-station boilers, the thermal efficiency is approaching 90 per cent, and it is extremely difficult to improve upon this figure. Similarly, there are domestic appliances that can utilize coal in almost as efficient a manner. If there is coal to burn, the technological problem—that of using it effectively—is in fact already solved. But solid fuel is a most awkward material to deal with, and it would be better to eliminate solid fuel if one could possibly do so. This is not impossible, and without question much will happen in the next ten years.

GASIFICATION OF COAL

One development, which has already begun, may be seen in the manufacture of town's gas. Hitherto special varieties of coking coal have been necessary, but these coals are becoming more and more difficult to mine and eventually supplies may cease. The iron and steel industry also depends upon a supply of coke from similar coals, and it is important that the supply should be adequate. Therefore we must find a way to make a gaseous fuel from other types of coal.

The solution to this problem is the complete gasification of almost any type of coal that might be mined in this country. As the mines are progressively mechanized, the quality of the coal is altered, and in particular the supply of coal in the finely divided forms is likely to increase very considerably. By this new process, almost any kind of small coal can be gasified completely into town's gas. I think this development is likely to make it possible for at least one sector of the fuel industry to utilize a much wider range of fuels than was possible in the past and to distribute a clean and convenient fuel.

GAS FROM OIL REFINERIES

There is also the possibility that more gas will be obtained from oil refineries and also possibly to some small extent by the importation of liquefied fuel from oil wells abroad. In the operation of big oil refineries there are inevitably gaseous by-products that are not wholly utilized for chemical or other purposes, and it is important to make sure that the economy of the oil industry in this country is properly balanced by utilizing every by-product. Undoubtedly large refineries handling tens of millions of tons of oil per year can make some contribution to the country's gaseous fuel requirements.

OIL FROM COAL

Again, it is highly desirable to make oil from home-produced coal. We need a very considerable amount of oil in this country—something like 30 million tons a year are now consumed in one way or another. If some of our coal can be converted into a liquid product it would be a tremendous advantage, but, according to present methods of working, it needs about five tons of coal to make one ton of liquid fuel. The reason for this is that one needs a very considerable amount of energy (and therefore coal) to accomplish this complicated chemical process. As we need 30 million tons of liquid fuel a year, we would consume no less than 150 million tons of coal if it were all made synthetically from coal. Since our coal production is something like 220 million tons a year, it is clearly quite impossible ever to contemplate a development on this scale. So it will appear that our oil supplies will have to come from abroad, in spite of complicating political factors. It is very unlikely that coal can be converted into oil in any large quantities.

ELECTRICITY GENERATION

On the electrical side the situation is rather different. Modern power stations can make use of low-grade coal in very large quantities indeed. These power stations are now highly mechanized, and many of them are close to a pithead, so the transport of fuel is not a great problem. Disposal of ash, which amounts to many millions of tons a year, is not an insuperable technical problem. On the electrical side, therefore, we have a tremendous advantage. The average thermal efficiency of the stations in this country is about 26-27 per cent,

* Based on the Opening Address to the BACIE Annual Conference held at the College of Aeronautics, Cranfield on 24–25 September, 1959.

so that only a quarter of the potential energy in the fuel appears as electrical energy. But that figure of 26 per cent is an average value, and it is brought down by the low efficiency of many old stations, which in due course will be scrapped. The most modern stations reach overall efficiencies of about 35 per cent, but it is unlikely ever to increase much beyond 40 per cent.

However, there is a very real technical problem in this country which has not been solved to any important extent. If one compares the total output of our electric power stations with their maximum possible output if run continuously, one finds that in effect half the generating capacity is not in use.

This is partly due to our social habits. In the morning one wants to switch on an electric fire, and to cook by electricity and to obtain heat and light from electricity during the day, and to some extent during the evening. In the same way industry tends to work during the day, and therefore the power demands are at the maximum during the normal working hours. In the evening the power demand falls off very steeply indeed; for a considerable period the plant is not being effectively utilized. The solution of this problem is very difficult: electricity cannot be stored in the ordinary sense of the word. One or two ideas are now being developed which may alleviate this problem, but they will never solve it completely. One of the most interesting ideas, which may seem a strange conception, but is in fact a practical proposition, is to use hydroelectric schemes to supplement, and to make provision for the storage of, electric power as required. During the night, when the load in the power system is exceptionally low, the power is used to pump water from a source—a reservoir at low level—up to a reservoir many hundreds of feet above that level. When the demand is high the pump is reversed and becomes an electric generator, and supplements the supply of electric power when it is most needed. It is possible to get an efficiency of about 70 per cent from such an operation, and therefore to provide for overnight storage of potential energy as stored water. The unfortunate thing is that few large reservoirs are available for this purpose, particularly in England. There are more in Scotland, but still it sets a definite limit to the amount of power that might be stored in this way. There is no question that many schemes of this kind will be built in this country, and, despite their high capital cost, they provide an economic means of spreading the load in our electric power system and therefore making it, overall, much more efficient.

NUCLEAR ENERGY

Other means of generating electricity are out of the question altogether. One sometimes hears of wind-power—a very attractive idea, but an impractical one. Solar energy in this country is also impracticable, because there is as yet no satisfactory means of converting it efficiently into electrical power.

The other big question is the contribution to be expected from nuclear power. When coal was in very short supply much pressure was brought to bear on those concerned to build nuclear power stations, although their capital cost was very much higher than the cost of steam stations at the time. But that position has changed. Coal is now much more easily available; and another factor has arisen which has changed the picture. About five years ago the capital cost of a conventional steam station was about £70 per kW of installed capacity; and nuclear power stations were then, as now, well over £100 per kW. Now the engineers have found that it is practicable to build far bigger units than have ever before been contemplated. After the war a standard electrical power unit developed about 30 MW; soon it became 60 MW and even 100 MW. Nowadays generators of 500 MW are being constructed, and the units (boiler and generator) are not much larger in size than the older ones. The result has been that the capital cost of these very large units is about £40 a kW instead of £70. Thus the relationship between nuclear power and coal-generated power has changed to some extent, and it is obviously desirable to postpone some part of the nuclear part of the programme until a later stage. It may be that when the efficiency of nuclear power stations is increased the capital cost will come down and the situation will be more evenly balanced. But it looks as if electrical power will be adequately available, in all the industrial regions, to meet all foreseeable demands.

RAIL TRACTION

The next topic I should like to consider is transport and communications. I hesitate to say anything about railways because I think here the technological problems are really solved. The big advance in railway traction will come about when the long main lines in this country are electrified, using a high-voltage alternating current. Of course that has already been done between Crewe and Manchester (London Road). I can think of only one technological change that might have a small effect, and that is in the nature of the transforming equipment needed to deliver direct current to the traction motors. As I shall mention later on, new devices are available to do this simply and efficiently and they will have an impact on the design of electric locomotives. This is not going to revolutionize the operation of the railways, but it will become possible to build electric locomotives more cheaply.

ROAD-BUILDING

As regards roads, technological methods already exist for making very substantial advances. In the past, roads and bridges have usually been constructed to last for ever, and their cost has frequently been far greater than necessary to bear even the traffic of today. There is a tremendous amount to do here, but there is

bound to be a gradual evolution as a result of experience and an appreciation of what modern road-building materials can actually do.

TRAFFIC ENGINEERING

There is more scope for technological advance on the traffic engineering of roads. Proper scientific surveys of existing traffic can be used to calculate road layout and other requirements for the future. This has never been done, except in a rather *ad hoc* way; but such studies will, I think, lead eventually to tremendous economies in the building of roads in this country. Again, it would be wasteful to embark on large road-construction programmes without adequate knowledge, because in many cases roads far bigger and wider than are necessary might in fact be constructed.

ROAD SAFETY DEVICES

It is not uneconomical to heat some roads electrically in winter, and this is particularly valuable when there is a frequent incidence of frost. Experiments have been made in which resistance wires have been laid immediately below the surface: these are automatically energized when the temperature falls to a definite value, so providing enough heat to check the formation of ice and make the roads safe. Enough information is now available to demonstrate that such a simple method can make, at low cost, a big contribution to road safety.

In the modern dual carriageway roads a cable could be provided under the surface, again energized electrically, so that one could steer a car by having an indicator on the dashboard to make sure one is on the right track. This merely keeps one going in the right direction—it does not prevent collisions between vehicles travelling in the same direction. To have a device to do that would not be out of the question, but it would be rather more expensive than most motorists would like to bear. Such a guiding line would enable traffic to move in conditions of almost zero visibility.

ANTI-SKID RUBBERS AND SURFACES

The cost of accidents is enormous in this country, and any technological measures that would enable this cost to be reduced are highly desirable. It is possible now to design the surface of a road in such a way that it possesses the highest resistance to skidding. The principles are well known. There is nothing new scientifically to be learned, but it is important that those who are responsible for building roads adopt scientific measures to make sure that the skid-proof qualities of the road are developed to the maximum. This is not the whole of the problem, for within the last year or two it has been found that the chemical nature of the rubber used to manufacture tyres can also have a very big effect on the ability to resist a skid. Hitherto the problem has been to develop rubbers, particularly synthetic rubbers, and to modify natural rubbers, in such a way as to get the maximum possible amount of wear; but this new factor is now being taken into account, and it may well be that in the very near future the character of the tread of the tyre will have to be chosen not only with regard to its resistance to wear, but also with regard to its skid-proof qualities.

C.I. *v.* I.C. ENGINES

Next there is the problem of prime movers for transport of all kinds. Here the pattern is, I think, clearly defined. There is no question that the diesel engine is pre-eminent in heavy road transport and in marine work, but it is not very highly developed for private motor cars. The reason is not very far to seek. A diesel-engined car of a few years ago is a most disappointing vehicle to drive—very heavy and extremely sluggish. One needs a six-speed gearbox to get any sort of performance out of the engine, and it is so unexciting to drive that few cars of this kind have been bought. But the picture is changing, and quite recently I drove a French car, with an engine designed and made in this country, which was completely different. It was not quite as smooth as one with a petrol engine, but the acceleration was something like that of a petrol-engined car and the consumption of fuel was just half that obtained with a petrol engine. So here is a technological advance that might well come about in the next few years. There are still problems to be solved because these engines are rather heavier and sometimes they have to be made with more precision than a petrol engine.

It is extraordinary that the old steam locomotive that still runs on our railways has an efficiency of about 5 per cent. This is really miserable because, as I mentioned before, a modern electric power station has an efficiency of about 40 per cent. On the other hand, the modern motor car, with the highest compression ratio of 8·5 or 9 to 1, has an average efficiency of only 7 per cent. This is rather staggering. The reason is that we like to have motor cars which can be driven at all kinds of speeds with outstanding acceleration, and we very rarely run the engines at maximum efficiency; one has to pay for these facilities. So here again there is a possibility of making some significant improvement in economy, and the result, as far as this country is concerned, is of course a reduction in the amount of fuel needed to maintain the transport system.

As regards transmission problems, the picture is again fairly clearly defined. In the not very distant future, even in this country, automatic and hydraulic transmissions will be adopted to an increasing extent and replace the rather crude gear-boxes and clutches which are a feature of most modern British cars.

HOVERCRAFT *v.* HELICOPTER

Another interesting development is the hovercraft. Here is a means of suspending vehicles in air very much

more economically than with aeroplanes. With helicopters also a large fraction of the power from the engine is used merely to rotate the blades and keep the helicopter and its load in the air. Now, the hovercraft is only suspended a small height above the ground and the power needed to maintain it there is very much less than would be required for a helicopter. It is restricted to moving over fairly smooth surfaces, and therefore it is unlikely ever to be much used in a country like ours. But in a desert, or even in the Arctic—for instance, Northern Canada, where there are no obstacles beyond the tree line—vehicles of this kind might find very considerable application in the future.

TRANSISTORS AND COMMUNICATIONS

Another matter of great importance is the problem of communications. The telephonic communication system and the radio communication system associated with it are being revolutionized very quietly but very thoroughly—through the invention of the transistor, a device which is only eleven years old, but has replaced the common thermionic valve and is the cause of this revolution. The scientific principles of this device were established in 1948 in America, and already it has come into full commercial operation. Telephone exchanges will change their character completely: they will be more compact and more reliable, and all the electromechanical equipment even of many modern telephone exchanges will entirely disappear. The resulting economy will lead to the more effective use of telephones in every respect.

TRANSMITTING INFORMATION

Another revolution will occur—not in the near future perhaps, but happen it will—in the means for transmitting information from one place to another. This has been done in various ways: for example, by making a photograph of the information and using the old-fashioned method of transmitting the picture over a period of many minutes, or, in some cases, by transmitting the information by television links. But these processes take some considerable time, and are not the most efficient.

Nowadays, particularly as a result of the development of electronic computors, it is possible for all kinds of data, like angular displacements, linear measures and characters—and maybe eventually speech, though that has not yet come—to be transformed into binary digital systems. That is, instead of using ten digits, as we normally do for counting, the number is reduced to only two—zero and one. It is possible, with suitable electrical and mechanical devices, to code all kinds of complex information into a binary system, and the great importance of this is that the information can then be transmitted electrically with tremendous speed. Instead, therefore, of using the traditional methods of transmitting information by photographs and television, machines rather similar to modern electronic computors will be used to code the information, transmit it and decode it at the other end, very much more quickly than is possible at the present time. That development is going to take some time, but it will continue because of its ultimate speed and economy.

NEW MATERIALS

The great problem of the development of new materials is being tackled vigorously, and here again tremendous changes are taking place and are bound to do so in the future. At the moment there is no question that metals are the predominant materials for all manner of purposes: they are the most important by a weight factor of probably 20, or even more. The organizations that are using metals in increasing quantities are also generating a need for technological advances elsewhere. The sources of rich ores of some metals are being worked out. This has always been a feature of mineralogical development, but in the last decade or so new methods of prospecting have been developed and have partly offset this tendency. These methods are more scientific, depending upon particular types of chemical reactions which may conveniently be carried out in the field, and give a more precise indication of where the mineral resources are located. Also, there are now improved methods of working up the mineral content of a rock. These may not be very spectacular, but if advanced methods of prospecting and mineral dressing had not been developed in the last ten years the price of uranium for nuclear power stations would be very much greater than at present—and the economics of nuclear power very different.

Tonnage Oxygen

Even in the traditional methods of making iron and steel the picture is changing. Whether the blast furnace will ever be replaced is still doubtful, but other ways of producing the metal exist. If these take a step forward, the blast furnace may not be so universal as it is now. One very considerable advance in steelmaking is already in operation and is likely to be increasingly applied—the use of relatively pure oxygen derived from the atmosphere instead of air for the purification of molten iron. Though until recently pure oxygen was too expensive, technological advance has provided liquid oxygen in very large quantities at a reasonable price, resulting in a transformation in steelmaking.

Another interesting development, which may well soon become a commercial proposition, is the continuous casting of steel by pouring it into a moving mould; when the steel solidifies the billet is ready for dispatch or further processing.

New Metals

The field of the 'new' metals is wide open, but as some of them are so extraordinary, one would hesitate

to predict their ever coming into commercial use. The fact is that the ores of some of them, *e.g.* titanium, are abundant and therefore they could be produced in greatly increased quantities. The cost of extraction is sometimes very high indeed, but for some applications they are essential. For example, beryllium, which until recent years had never been made commercially, is necessary for the cladding of fuel elements in nuclear reactors. Here one has just got to use beryllium, and to make it in a reasonable quantity has been an outstanding technological achievement. When such a metal is needed for a specific purpose, the chances are that it will find application in other directions and prove more generally useful than at first seem likely. Tantalum and zirconium have unique properties; for example tantalum, a white silvery metal and rather brittle, stands up to corrosive conditions where no other metal or alloy is suitable.

Materials of Very High Purity

The production of high-purity silicon and germanium for transistors is also an outstanding achievement, for the impurity level must be less than one part in several millions by weight. Fortunately methods, simple in principle, can be and are being developed to produce these materials in the extremely high degree of purity necessary for these applications.

SYNTHETIC ORGANIC MATERIALS

Another considerable development since the war has taken place in the realm of synthetic organic materials like rubbers, resins and plastics. It is surprising that even in this small country about half a million tons a year of these materials are now made. This level of production is comparable with that of non-ferrous metals like copper and zinc. Looking to the future, therefore, it is not impossible that some of these materials may be used as alternatives to non-ferrous metals. Most of them do not corrode, but the main trouble is that a good many of them begin to soften a little above 100°C. Even this difficulty may be overcome with time, and these materials may well prove important in various industrial connections in addition to their domestic applications. One particular plastic is already being used in considerable amounts in chemical plant. This material can be made in a rigid form and is absolutely unaffected by all kinds of aggressive chemicals. For many purposes it is much superior to any metal, coated or otherwise, for the construction of chemical plant. As regards rubbers, we already have in this country a very considerable synthetic rubber industry and the plants now supply a considerable fraction of our total requirements. There is great scope for the development of new types of rubbers, not only for tyres but for many other purposes. That advance will go on increasingly in the future, though natural rubber will still play an important role.

Man-made Fibres

Another development, equally likely to increase, is the production of man-made fibres. Some of these materials are made from oil-refinery products, and thus their prices are likely to be stable; they will not be affected by external economic conditions—one incentive for further development. But these fibres can be designed for specific purposes, and it is likely that, with more complete exploitation, they will displace some of the more traditional fibres. Suitable fibres can now be blended to provide the necessary qualities.

The cost of developing a new fibre is so extremely large that few firms are willing to undertake it unless the objectives are very clearly defined. For instance, to put Terylene into production in this country Imperial Chemical Industries Ltd had to spend about £20,000,000, not only on the initial development, but also on the construction of the pilot plants and the production plants. One can imagine the commercial side of a great business almost begging the research side not to invent new fibres too frequently, because the firm might be saddled with an expenditure of many millions of pounds to exploit the new developments commercially. I do not think that would deter any really good research and development manager, but it does emphasize the huge expense incurred in producing a new material of this kind. It is therefore of the utmost importance to establish whether there is indeed a market for the new product.

ELECTRONIC CONTROL DEVICES

There has been a great deal of talk about automation, many people thinking that it implies something radically new in manufacturing technique. However, automatic methods of shaping or producing materials are just a logical development of older processes. There is nothing basically new here, but certain new developments will certainly transform some methods of manufacture. For example, a complex metal component, with an essentially cylindrical shape, was traditionally produced on a hand-operated lathe. If a number of operations had to be done in sequence on such a specimen it was desirable to have a multiplicity of tools mounted on a common rotating head so that each operation could be carried out without adjustment of the individual tools. In that way the more complex lathe developed, still manually operated. The next development was a machine to measure the size of the specimen being produced; when the size had reached its specified value the machine stopped and the component was removed. One can imagine a sensing element to measure what is being done and to control the time of operation until the specified dimensions of the article have been achieved, the whole process becoming completely automatic. A similar kind of development occurs in the production of a complex structure, such as the cylinder block of a motor car engine. Many holes

have to be drilled in the casting, and multiple-headed drilling machines can perform a certain number of operations in a particular direction. Then the work has to be transferred to another machine and another sequence of operations carried out—and so it goes on. Now if the transfer of the unit, and its accurate positioning from one machine to another, is brought about automatically, we reach the stage of a transfer machine, and the whole process is called automation. It is a logical development of simple machine techniques to something which is almost wholly automatic in its character.

A much more important development is occurring now in the fabrication of metal components. It is necessary to machine metals in three dimensions and to rather complicated shapes. Previously that was done by highly skilled machinists, who had to operate the precision machines by hand. The new development consists in specifying the shape of an article in three dimensions and encoding these dimensions. The next step is to feed these coded instructions into an electronically-controlled machine, and this will then produce an article in three dimensions without the intervention of human control.

Automation in Ship-building

Another similar development may well have a big impact on the ship-building industry. Plates and beams are initially fabricated in the steelworks and then transported to a shipyard. Here, in the lofting room, full-scale drawings are made of the plates and beams, and then, in the cutting shops, these beams and sheets are tailored to shape. But in so doing a tremendous amount of steel is discarded and eventually returned to the steel works. In view of the high tonnages of steel used, this is rather a serious matter. What is proposed now is that when the naval architect has designed his ship the drawings should be sent first to the steelmaker, who can then use a computing machine to calculate the size of the plates and beams needed for the structure of the ship. This information is then fed into a computer operating a gas-cutting equipment to produce plates of the required size. The waste is retained in the steelworks. With such a development the time and cost of construction of a ship might well be cut significantly and the layout of shipbuilding yards very much simplified.

Automation in the Chemical Industry

The same kind of thing can be done in chemical plants. Twenty years ago the normal procedure was to measure the flow of the materials, record pressures and temperatures and, as a result of experience and experiments with pilot plant, set the controls so that the flow, pressure and temperature were maintained within certain limits. This was done on the supposition that the products would be equally closely specified. But things do not always happen in that ideal way. Since the war techniques have been developed for the analysis of multi-component mixtures in chemical plants within a matter of seconds and the display of their composition on suitable graphical recorders. With that knowledge it is possible to control a plant manually with a reasonable degree of precision. But this is not enough; if these analytical devices can in fact record the chemical composition of the ingoing and outgoing products the next step is to make them automatic and of a controlling character. In other words, if the chemical nature of the output in a chemical plant, including an oil refinery, is specified, then by feeding this information into a computer, the settings of the control devices can be worked out to ensure that the product conforms to the specifications. This has not yet been done in any country that I know of, but attempts are being made to do it on a pilot-plant scale. Its importance can be appreciated in a modern oil refinery. Here one has a feed-stock coming from overseas with a very large number of chemical components in it. The refinery has to meet certain demands for its various products, and it is up to the refiners to treat the incoming crude oil in such a way as to produce these products in the required quantities. This is a very complicated operation and at the moment requires a very large staff; but with physical analytical devices used in conjunction with computers, it will be possible to control a complex plant in a way that would be beyond the wit of any human being or group of human beings. Many similar developments may occur in the not distant future.

NEW TEXTILE PROCESSES

Developments in the textile field are perhaps a little more speculative. The production of a woven cloth is really a very laborious and rather discontinuous process. A fibre, natural or synthetic, has to be pulled out, made into a yarn, twisted, made into thread, woven and subjected to finishing processes—a very extravagant process in manpower and machinery. Much work is now being done to ascertain whether it is possible to simplify this mechanical procedure and to produce a machine that will conduct the whole sequence of operations in one. Even more revolutionary is the attempt to make a cloth without weaving at all. It is extremely wasteful to tie things together, as in knitting or weaving, and it is not impossible to bond fibres together by laying one over the other, thus producing something looking like a woven cloth by much simpler and much cheaper methods. Though only in its infancy, it may well alter the character of the textile industry in the not very distant future.

These are only a few of the possible trends in technology. How quickly they will develop it is difficult to say, for the rate of technological progress is dependent not only on research and development but on many factors not relevant for discussion here.

Book Reviews

A HISTORY OF GREEK FIRE AND GUNPOWDER. J. R. Partington. Pp. xvi + 381. *Cambridge: W. Heffer & Sons Ltd*, 1960. 70*s*.

This volume amply fulfils the expectation aroused by the announcement of a new book by Professor Partington. It provides a complete and systematic marshalling of a vast body of evidence (and previous opinions) on each aspect of Greek fire, of gunpowder and of ballistic instruments. There are most entertaining illustrations from sources beautifully documented.

The book opens with a general chapter on incendiaries in warfare from missiles shown in Assyrian bas-reliefs through the Greek, Roman and Byzantine periods to the Crusades. After discussion of the various answers to the important question *What is Greek Fire?* Partington expresses his certainty that the Greek fire used by the Byzantines and by their Moslem invaders was *not* gunpowder as has sometimes been suggested. He concludes: 'It is very probable that the basis of the earliest Greek fire was liquid rectified petroleum or volatile petrol which was projected in hand grenades, or ordinary petroleum in tubs shot from ballistae.'

An epitome is then given of the famous text *Liber Ignium* ascribed to one Marcus Graecus. Partington considers that there is no evidence that the text as it has reached us is the work of a Greek. He suggests that it is a collection from various sources, some going back to the eighth century, some from the Arabic, and that it may have been compiled in Spain by a Jewish writer in the late twelfth or early thirteenth century.

After the medieval period, we meet the persistent tradition of gunpowder as a monkish invention inspired by the devil. Unlike some earlier scholars, Professor Partington is inclined to uphold claims made for Albertus Magnus (*c.* 1193-1280); and for Roger Bacon (*c.* 1214-1294) he gives chapter and verse. There is a helpful short section on Michael Scot (?1180-1236). The legend of Black Berchtold is well and truly demolished and the odd pride is noted of the Mayor and inhabitants of Freiburg-im-Breisgau in a supposed fellow-citizen.

With beautiful clarity a survey is given of the various types of early gun used in Europe, from that shown in the drawing of *c.* 1326 in MS. XCII of Christ Church, Oxford (which is reproduced as a frontispiece to this volume) to large guns and mortars in the sixteenth century. An interesting section deals with names of guns and describes the various kinds of these weapons. A chapter on 'Miscellaneous Treatises on Military Arts' gives epitomes, bibliography and extracts with some excellent reproductions of figures from works ranging from the *Bellifortis* of Conrad Kyeser of Eystadt (1366-1405) written at the turn of the fourteenth century, to the *Traité des Feux d'Artifice* of 1706 by Amédée François Frezier.

Further chapters deal with both the early forms of ammunition and the early firing weapons in Moslem lands; in 'India under the Moghul Emperors'; under the Portuguese with large guns made in India; one in Burma; and one which was perhaps Turkish and was taken from Crete to Verona. A chapter is given to 'Pyrotechnics and fire-arms in China.' A final most interesting and exhaustive chapter is devoted to saltpetre. A volume covering so vast a field and with so much respectful citation of earlier investigators has necessarily some loose ends, but these are mitigated by the fullness of the indexes. Every student of the subject will be grateful to Professor Partington for this splendid work.

DOROTHEA WALEY SINGER

AN ELECTRONIC OUTLINE OF ORGANIC CHEMISTRY. S. Horwood Tucker. Pp. xvi + 478. *London: University Press Ltd*, 1959. 63*s*.

It is no longer adequate for the student of organic chemistry to know merely the reactants, conditions and products of reactions. He must also know the route and rate through the transition state, and the various factors by which these are governed—that is, the reaction mechanism. A number of good textbooks are now available which develop this mechanistic theme alongside the purely descriptive material, and most undergraduate lecture courses adopt a similar approach.

Dr Horwood Tucker's book attempts to provide a conversion course for students who have learned their organic chemistry the older, harder, non-mechanistic way, and aims to present compactly the basic theory for a working knowledge of organic reactions.

The Lewis picture of the formation of ionic, covalent and co-ordinate bonds is first summarized, and then elaborated in terms of the inductive and conjugative electron displacements. The usual homologous series of aliphatic compounds—paraffins, olefins, dienes, acetylenes, alcohols, aldehydes and ketones, and so on—are then discussed in terms of the mechanisms of their reactions. Separate chapters are devoted to topics such as the contrasting reactions of the olefin and carbonyl double bonds, the competition between nucleophilic substitution and elimination, the Walden Inversion, the strengths of acids and bases, and to intramolecular rearrangements. About one-fifth of the book deals with reactions at or adjacent to a benzene ring, and the final chapter with heterocyclic compounds.

There is little in the book to which the specialist in reaction mechanism would take exception, although some explanations and illustrations, such as the definition of the transition state, the distinction between order and molecularity, and the diagram of the formation of the π-orbitals of acetylene, are imprecise. I question the value of including a brief section in Chapter I on atomic and molecular orbitals; no use of this approach appears to be made in any later section, and in such a

mall compass the account might confuse rather than larify the students' ideas.

There seems to be a case for a book of this standard o serve as a stepping-stone to the more advanced texts n reaction mechanism, and Dr Horwood Tucker has nade a useful contribution to this branch of chemical terature.

A. G. DAVIES

DVANCES IN ORGANIC CHEMISTRY: METHODS AND RESULTS. VOLUME I. Edited by R. A. Raphael, E. C. Taylor and H. Wynberg. Pp. ix + 387. *New York: Interscience Publishers, Inc.; London: Interscience Publishers, Ltd*, 1960. 90*s*.

The appearance of another monograph, the first of a eries, dealing with methods of organic chemistry nevitably causes one to reflect whether or not it is really ecessary in view of the several other series already in xistence. The justification given in the introduction is, f course, the rate of progress of the subject and the time equired to disseminate new methods and ideas to rganic chemists in general. In spite of the fact that ne or two of the topics selected for review in this first olume, each written by experts in the particular field, ave been reviewed elsewhere in the last few years, there s no doubt that this is a very useful collection. For xample, Weedon himself reviewed the Kolbe synthesis Chapter 1) in 1952, the Wittig reaction (S. Trippett; Chapter 3) has been reviewed recently in *Angew. Chem.*, nd parts at least of all the other chapters have been nentioned in other reviews. The remaining chapters vill each evoke much interest: the uses of polyphosphoric cid in organic chemistry (F. Uhlig and H. R. Snyder), nethods of hydroxylation (F. D. Gunstone), the selective legradation of proteins (90 pages; 345 refs.) by E. O. P. Thompson and optical rotatory dispersion and the study f organic structures by W. Klyne (100 pages; 202 refs.). The selection thus covers a wide and useful range and he material presented is up to date; an inspection of the eferences quoted show that they include several as ecent as 1959.

The arrangement and general format of the book are xcellent but the price will deter most individual urchasers.

A. W. JOHNSON

HE CHEMISTRY OF PLANT GUMS AND MUCILAGES AND SOME RELATED POLYSACCHARIDES. F. Smith and R. Montgomery. Pp. x + 627. *New York: Reinhold Publishing Corporation; London: Chapman & Hall Ltd*, 1959. 144*s*.

Although numerous textbooks on the chemistry of tarch and cellulose are available, the chemistry of the ther plant polysaccharides has hitherto been described nly in review articles, or in chapters in general textbooks f polysaccharide chemistry. The present volume herefore fulfils a real need in providing a comprehensive and up-to-date account of the structural chemistry of plant gums and mucilages.

The general plan of the book is excellent. The first three chapters describe, respectively, the function and origin, the classification, and the occurrence and isolation of the gums and mucilages. Earlier classifications into 'gums' and 'mucilages' were based on physical properties, especially solubility in water, but it is now evident that there is no chemical basis for such a classification; indeed, there is no clear demarcation between the two groups of polysaccharides. The detection and identification of gums and mucilages is then detailed in the fourth chapter.

The next six chapters are concerned with the methods of polysaccharide chemistry and, as such, will be extremely useful to all carbohydrate chemists. The topics covered are the separation of mixtures of polysaccharides, the molecular weight of polysaccharides, analytical procedures (which include full experimental details of modern chromatographic methods), determination of structure (dealing primarily with partial acid hydrolysis methods and the separation of neutral and acidic oligosaccharides), periodate oxidation and finally the separation and identification of the hydrolysis products of the methylated polysaccharides. The chapter on periodate oxidation is of special interest since it contains details of the analytical method developed by Smith involving reduction of the periodate-oxidized polysaccharide to the corresponding polyalcohol and subsequent total or partial acid hydrolysis or methylation. This section of the book is exceptionally complete except for the deliberate omission of even brief details of physical methods for determining the size and shape of polysaccharides. In general, physico-chemical aspects of the chemistry of the mucilages and algal polysaccharides have not been emphasized (Chapter 17 devoted to 'Physical Properties' covers only four pages), and there is no apparent appreciation of the difference between number-average molecular weight values as obtained by chemical methods and osmotic pressure measurements, and weight-average molecular weights as determined by sedimentation and viscosity measurements.

The eleventh chapter contains an account of the structure of the gum exudates; particular attention is paid to gum arabic, but the structures of damson, peach, mesquite, ghatti, cholla and *Khaya grandifolia* gums are amongst the many extensive accounts. This chapter amply illustrates the difficulties involved in investigating such complex highly-branched polysaccharides, and the successes which have been achieved by the application of modern methods.

The next three chapters are full of interest and contain a wealth of experimental detail. They describe the gums and mucilages from the seeds, roots and leaves of land plants, the lichen polysaccharides, and the bewildering variety of polysaccharides synthesized by various marine algae. The final chapters describe the

application of immunological reactions to the analysis of gums, the synthetic gums and gum derivatives, and physical properties.

The subject matter is completed by an appendix describing the commercial applications of gums and mucilages, and an extremely valuable appendix listing the physical constants of the methylated derivatives of the monosaccharides.

An outstanding feature of the book is the comprehensive bibliography at the end of each chapter, which may involve several hundred references; papers published in 1958 and even 1959 are included. The numerous structural formulae are clearly presented, and the general production of the book is of a high standard.

I have no hesitation in unreservedly recommending this book. Despite the high price, it is an essential purchase for all polysaccharide chemists and a copy should be available in all chemical libraries. It will be read with pleasure and interest by all students of natural product chemistry. The authors, whose critical writing is based upon first-hand practical experience, deserve our congratulations on having produced such an accurate and authoritative account of this fascinating branch of experimental organic chemistry.

D. J. MANNERS

DIE MANNICH-REAKTION. B. Reichert. Pp. viii + 195. *Berlin: Springer-Verlag*, 1959. DM 36.

The Mannich reaction, which involves the condensation of an amine and an aldehyde with a third compound containing an 'acidic' hydrogen atom attached to carbon or nitrogen has, since its discovery by Tollens in the early years of this century, found wide application in synthetic organic chemistry and well merits a book to itself, in spite of the existence of two excellent review articles (Blicke, *Organic Reactions*, 1942, i, 303; Schröter, *Houben-Weyl*, 1957, ii (1), 751). Professor Reichert is particularly well suited to write such a book, since he was a pupil of Mannich.

The present book deals with both the preparation and reactions of Mannich bases. It is essentially a 'practical' work for the laboratory organic chemist; although it does not entirely neglect the mechanistic aspect, its great strength lies in its extensive coverage of the preparation and reactions of the various types of Mannich bases, including full practical details of over 60 preparative reactions. The text concludes with a 50-page, classified list of Mannich bases of various kinds, in the preparation of which the literature has been covered up to 1958; this is remarkable, in these days of slow publication, for a book published in 1959, and, although I noticed one or two omissions, the list appears to be reasonably complete.

The book is well produced, in the typical Springer fashion; the price is high, but not unduly so for so specialized a work. All synthetic organic chemists should have access to this volume.

H. N. RYDON

ATOMIC RADIATION AND POLYMERS. A. Charlesby. Pp. xiii + 556. *London: Pergamon Press Ltd*, 1960. 110*s*.

The name on the title-page alone suffices to commend this book to a wide audience since no one has contributed more to our understanding of the effects of high-energy ionizing radiation on organic polymers than Professor Charlesby. The title links ostensibly unrelated subjects —atomic radiation and polymers—but it soon becomes evident to the reader why this title has been chosen and why polymers have figured so prominently in radiation chemical research. When dealing with relatively small amounts of radiation, the low yield of product from the irradiation of simple organic compounds may tax analytical resources. The proportion of material converted per unit radiation dose depends on the number of molecules changed per 100 eV of energy absorbed (the *G* value) and the molecular weight. In the polymer field, both high *G* values (chain polymerization) and high M.W. values are available, factors greatly aiding detection of changes caused by delicate doses of radiation.

At the same time, the coupling of these subjects has posed problems for the author, because the average radiation chemist is as unfamiliar with polymers as the average polymer chemist is unversed in radiation concepts. Frequent introductory digressions therefore appear in this book designed to accommodate readers of diverse disciplines.

During 10 years of research, initially using the unique facilities at Harwell, the author has published work on the irradiation of simple hydrocarbons, on the cross-linking and reinforcement of polythene, natural rubber, polystyrene and silicones, on the degradation of cellulose, polyisobutylene, polymethyl methacrylate and polytetrafluoroethylene, on polymerization and grafting reactions and on radiation protection. All these pioneering contributions are summarized in this book, the approach being that of a physicist, concerned primarily with radiation but drawn into a consideration of polymer statistics and kinetics in order to interpret the radiation effects. With a remarkable flair for mathematical analysis, fundamental parameters and correlations have been derived which have facilitated rationalization of a field which involves most complex chemical changes.

As might be expected, those chapters relating to the author's work are excellent. The chapter on nuclear sources of radiation is very useful in reconciling various radiation dose units, while those chapters dealing with dosimetry and cross-linking and degradation mechanisms are exemplary of the desired critical approach to experimental and interpretative difficulties. In other areas, however, the coverage of the literature is incomplete and the treatment tends to be patchy and uneven. Although the book carries a 1960 dateline, certain papers published in 1958 and 1959 have been neglected. Owing to the long delays in producing a book, the author cannot be blamed for this, but in a field advancing as

rapidly as radiation chemistry, neglect of recent papers tends to create a distorted impression of the current viewpoint.

There is some evidence of looseness of style and hasty proof-reading but not an undue amount. The reader may well be confused by references to *chlorine* evolution from PVC (p. 315) and to the *decrease in zero tensile strength* of PTFE (p. 349). The caption to figure 22.5 refers to *methyl acrylate*, whereas the corresponding text refers to *tetraethylene glycol dimethacrylate*. Inconsistencies also appear in the references, some of which are given complete at the end of one chapter but are given as *in press* at the end of another.

These points are offered only with a view to aid correction in a subsequent edition or reprinting. They do not detract from the excellence of the manuscript as a whole, which I regard as indispensable reading for all interested in radiation chemistry, despite the cost.

A more serious criticism is the neglect of the patent literature. Most work carried out by U.S. companies first becomes known by this route and there are at least a hundred granted U.K. and U.S. patents on the irradiation of polymers, yet only four patent references appear in the entire book. Unhappily, much patent data is considered unreliable but this criticism applies equally to results claimed in early declassified reports, which are reproduced in this book and thereby given some stamp of veracity, *e.g.* Table 22.10. On the whole, the complete neglect of the patent literature so prevalent in semi-academic treatises is to be deplored.

S. H. PINNER

POLYMER. Volume 1, No. 1 (The Chemistry, Physics and Technology of High Polymers). Edited by C. H. Bamford *et al.* Pp. 124. *London: Butterworths Scientific Publications Ltd*, 1960. £5 per annum.

At a recent meeting of the Scientific Publications Council it was stated that each year 700 new journals are taken by the Science Museum Library alone. It is becoming increasingly difficult for scientists to scan more than a very limited proportion, and the tendency to publish scientific papers in specialist journals is therefore to be welcomed.

Polymer science is one of the subjects which has developed most rapidly in the last decade. Publication of scientific papers in this field often occurs in non-specialist journals or in the *Journal of Polymer Science* which has therefore increased from a small bulletin of 158 pages in 1945 to a journal of 4,256 pages in 1958. More recently it has thrown off a branch—*The Journal of Applied Polymer Science*. Although there has been no substantial increase in cost per page, the annual price of the complete publication severely restricts the circulation of its contents.

The journal under review falls outside this publishing family and its appearance is to be welcomed both as offering an alternative source of publication and as a journal which can be purchased by less specialist libraries, without serious inroads into their funds.

Many of the subjects dealt with in polymer science are of interest to solid-state physicists, organic chemists and biologists, and the first issue of *Polymer* contains papers of direct interest to all three disciplines. Many of these papers are sufficiently wide in scope to be read by anyone interested in the behaviour of polymeric systems. It is to be hoped that the journal will avoid publication of a wealth of papers which, although having good scientific merit, are of direct interest to only a small number of specialists.

The international standing of the journal is assured by the eminent members of the editorial board. The presentation and printing of the new periodical are of a very high order and help to make the journal very readable. The cost of £5 per volume of four issues will unfortunately restrict its purchase to libraries, as the number of volumes published per year increases. May one suggest that the policy of the journal be to restrict publication, as far as possible, to articles of fundamental interest and avoid cluttering up the forest by planting too many expensive trees! There is an obvious need for a journal which can keep one abreast of the major lines of work, without becoming involved in technological details.

A. CHARLESBY

MODERN COORDINATION CHEMISTRY. Principles and Methods. Edited by J. Lewis and R. G. Wilkins. Pp. xvi + 487. *London: Interscience Publishers Ltd*, 1960. 80*s*.

The term 'physical chemistry' defines not so much a distinct branch of chemistry as an attitude of mind which is primarily quantitative. The physical chemist's approach is to define and measure some physical properties of chemical substances and then to perceive the relationships between the numerical values and chemical structure. The theoretical chemist seeks the explanation for these relationships and, frequently, his enquiries and hypotheses point the way to further physical measurements which can provide significant new knowledge. This symbiosis between physical and theoretical chemistry is well understood and of long standing. The last two decades have seen remarkable and highly beneficial interactions between each of these disciplines and inorganic chemistry. In no part of inorganic chemistry has this development been more strikingly advantageous than in the field of co-ordination compounds of the metals. It has so transformed the attitude of the inorganic chemist that instead of being content with the isolation of a solid ML_xA_y (M = metal, L = ligand, A = anion or cation) and knowing that it forms a coloured aqueous solution, that the oxidation number of the metal is increased by reaction with certain oxidants and not by others, and so forth, he now wants to know the precise

spatial distribution of ligands about M; the magnetic properties of the solid and the solution; the infra-red, visible and ultra-violet spectra of the compound and any constituent ions; the Arrhenius parameters of the redox and isotopic exchange reactions into which the compound can enter and the effects of medium, including pH, ionic strength and isotopic composition, on these parameters; and lastly, the values of the increments in thermodynamic functions associated with the addition of each ligand molecule. These data can then be interpreted by the use of several theories, prominent amongst which are the crystal and ligand field theories, so as to reveal the nature of the interactions between metal and ligand, ion and solvent and counter-ion.

The book under review is about precisely these matters and it would be difficult to praise it too highly. It is authoritative, remarkably self-sufficient, in the sense that the beginner can learn what measurements he should make, how to make them and how they should be interpreted without recourse to other books, although he will naturally need to consult original papers. The style is everywhere lucid and felicitous, the arguments are cogent and each chapter is a well-balanced and logically-constructed essay. The editors have done their work well and are to be particularly complimented on achieving good cross referencing and minimization of unnecessary overlap and repetition. The book is well produced; there is an occasional word omitted (*e.g.* page 402, line 3), very occasional use of lower case for capital (*e.g.* page 419), occasional misuse of cursive type, and an insufficient definition of equilibrium constant as a ratio of forward and reverse *rates*. One hopes that it will ultimately become known that the name of a double-Nobel-Prize-winning family does not contain a 'p' (page ix)! Such criticisms are trifling in relation to the generally very high quality of this book, the purchase of which can be confidently recommended to chemists of all persuasions who will find something of interest and value between its covers and in reading it will gain an excellent insight into the theoretical and experimental methods used in an important and rapidly developing branch of chemistry. My congratulations to the authors.

F. S. DAINTON

ADVANCES IN MASS SPECTROMETRY. Edited by J. D. Waldron. Pp. xiv + 704. *London: Pergamon Press Ltd*, 1959. 120*s*.

This volume contains a record of the papers (some 40 in number) presented at a conference in London in September, 1958, and extracts from the discussion at the meetings. The conference was organized by the Hydrocarbon Research Group of the Institute of Petroleum and by A.S.T.M. Committee E.14, and both bodies deserve congratulations on the galaxy of talented contributors which they managed to attract from both sides of the Atlantic. The next point which strikes the reader is the diversity of subjects which are covered by the papers. The range of topics treated includes some of the intricacies involved in the design of instruments, fundamental contributions to physics and chemistry, new analytical applications and, finally, the use of the mass spectrometer in geological studies.

Some idea of the main directions in which advances are being made can be gained from a study of the headings used for the five sessions of the conference—High Resolution Mass Spectrometry, Mass Spectrometry of Solids, Applications in Organic Chemistry, Ionization and Electron Impact Studies, and the Use of the Mass Spectrometer in Fundamental Research. Although a few of the papers may deal with topics of little direct interest to chemists, it is surprising how many different fields of chemical research are benefiting from the use of this versatile instrument. Everyone is aware of the capacity of the mass spectrometer to analyse complicated mixtures of gases but interesting developments include the determination of impurities in solids, the analysis of corrosive gases and the identification of organic compounds by high resolution mass spectrometry. The possibilities of this last technique are particularly fascinating—ions such as $C_2H_4^+$, CH_2N^+, N_2^+ and CO^+ all have a nominal mass of 28 but they can be identified individually if the resolution of the instrument is high, and this can be done also for many pairs or triplets of higher mass.

Many problems in physical chemistry too are being tackled with mass spectrometric techniques; these include the studies of reactions between ions and molecules, the interactions of electrons with molecules, the determination of bond energies and the formation of radicals on hot metal surfaces.

The volume contains numerous illustrations and the diagrams and photographs are clear. An unusual and valuable feature at the end of the book is the inclusion of a bibliography of the subject covering the period 1938 to 1957. This bibliography contains over 2,000 references and was prepared by the Research Department of Metropolitan-Vickers Ltd. The price of the volume is high but it is a worth-while purchase, because it represents the position attained in 1958 in a rapidly developing subject.

CHARLES KEMBALL

HETEROMETRY. M. Bobtelsky. Pp. 229. *Amsterdam: Elsevier Publishing Company; London: D. Van Nostrand Co. Ltd*, 1960. 42*s*.

Heterometry is a process of turbidimetric titration in which nucleating chemical systems are studied by means of light absorption measurements. The technique, which has been expounded by the author and his co-workers in a series of over 80 papers from 1953 onwards, has a much wider scope than turbidimetry and is capable of furnishing a broader spectrum of fundamental data. It is usually necessary to stabilize

precipitates as colloids in turbidimetry, but in heterometry the nucleating system remains undisturbed. Critical points on the curves relating optical density to titre can be used as analytical end-points and also to study the nature of the primary particles brought down at various stages during the reaction.

General aspects such as scope, relationship to other physical methods and also technique and instrumentation are discussed in the first three chapters. Then follows another chapter on analytical aspects and the largest section of the book which is concerned with analytical methods. The remainder of the text deals with the study of the insoluble complexes of dicarboxylic acids, meta-phosphates, thio-compounds, dyestuffs and so on, and goes on to discuss the study of chemical reactions by heterometry with examples drawn from heterogeneous chain systems and final and intermediate compounds.

It is difficult to assess the technique since it is, as yet, relatively untried. In relation to other analytical methods it is perhaps more sensitive than conductimetric titration and more versatile than turbidimetry, but it is probable that it offers little advantage over amperometry and conductimetric titration at radio-frequency, or indeed with spectrophotometric titration. Recently many new titrimetric procedures have been described, for example, enthalpymetry, chronopotentiometry and photonometry, to mention only three, and the new technique must compare favourably with these as well as the conventional methods before it can achieve widespread usage.

On the other hand it must be admitted that very little is definitely known about the process by which ions or molecules in solution nucleate and change phase to become primary precipitate. It is probably here rather than in analysis that heterometry may make its most useful contribution. The uniquely suitable nature of the method is clearly apparent in chapters 7-10.

The book is well written, though there are some curious views expressed about the techniques of micro-chemistry and the future of analysis on page 23; some difficulties of translation are in evidence, but these do not mar the text. Finally it must be said that Professor Bobtelsky has performed a very useful task in expounding his technique in this well-produced monograph.

T. S. WEST

SMALL-SCALE INORGANIC PREPARATIONS (FOR SCHOOLS). H. Holness and R. D. Langstaff. Pp. vi + 57. *London: Sir Isaac Pitman and Sons Ltd*, 1960. 6*s*.

Though the authors stress that this booklet is not planned as a complete course of inorganic preparations, a careful selection from the 42 examples given would undoubtedly provide an adequate training for candidates for the Advanced Level of the G.C.E. Indeed, simplicity being their hallmark, many of the exercises could well be attempted by pupils below the sixth form, who would obtain thereby a valuable introduction to small-scale practices.

Two sets of apparatus designed by Mr Holness for semi-micro analysis and for organic preparations, supplemented by a few pieces of usual bench equipment, form the basis for the methods described; the saving in materials and in time, an attractive feature of his earlier works, applies equally to the present one. With two or three exceptions, where crystallization is slow, the maximum time required is one hour and the yields obtained, though small, are sufficient to allow identification tests to be carried out.

The advantages of semi-micro methods in analysis are becoming widely recognized in schools; the adoption of such methods in preparative chemistry will, doubtless, occur less readily, for many will feel that one of the requirements is a sizeable yield of product. Nevertheless, trials by my pupils have realized the specified quantities without any practical difficulties—which cannot always be said for macro-methods!

The book is free from typographical errors and descriptions are always clear and concise. Like its two predecessors, it should form a valuable addition to school laboratory manuals. But laboratory use always shortens the life of a book; might it be suggested that at a future date the three books be included in a single volume in stouter binding?

H. J. SHEPPARD

LABORATORY INSTRUMENTS: THEIR DESIGN AND APPLICATION. Second Edition. Revised by A. Elliott and J. Home Dickson. Pp. xvi + 514. *London: Chapman & Hall Ltd*, 1959. 55*s*.

The title of this book, if not actually misleading, fails to give an adequate picture of its contents. It should should be helpful therefore to list the nineteen chapters: general considerations; the accuracy attainable in machining operations; properties of materials used for general construction of instruments; casting and jointing of metals; preparation of drawings; constrained motion and constraints; the magnification of small displacements; sensitivity and errors of instruments; isolation of apparatus from disturbing influences; damping; tests for straightness, flatness and squareness; glass; natural and synthetic optical crystals; the working of glass; lenses, mirrors and prisms; optical instruments; radiation and photometry; photography in research; corrosion in instruments and its prevention. In addition there are five appendixes: computation of a corrector plate for a Schmidt camera; notes on ray-tracing; angular measurement; nuclear radiation, protection and stabilized glass; table for use with Sayce resolution chart.

The authors have had in mind that 'in every research establishment a considerable amount of equipment is made by the workshop, usually to the design or instructions of the research worker.' It is hoped, however, that the book may also be of use to the professional

instrument designer. It may be said at once that the book contains a very great deal of useful information and, although the list of contents may look like a pot-pourri, nevertheless, to have a miscellaneous collection of information in one cover makes it an invaluable reference book in the laboratory. Those laboratories with good workshop facilities, particularly those where the research workers themselves are also highly skilled craftsmen, will in the main have built up a useful background of knowledge, skills and techniques, but even they should find much here of value. There has also been of recent years a much greater appreciation in the instrument firms of those features of design which are important in everyday laboratory use, but one still finds equipment to be inconvenient or inadequate either through ignorance of actual working requirements or because production methods preclude the use of more expensive refinements in design.

The book is of more value as a source of inspiration than as a practical 'instruction book.' It points out what can be done and gives general guidance on the techniques to be used. This function is very greatly assisted by the copious references both to literature and to other textbooks, where the reader will find the details which are of necessity omitted in covering such a wide field as the one dealt with here.

The treatment of the sections is somewhat uneven, with the greatest emphasis on optics. A little more information on heat and on control of temperature and also on surface finishing and corrosion would have helped to balance the book as a whole and to justify the publication of this second edition. It should be noted that electronics are not included 'since any adequate treatment of electronic instruments would have made the scope of the book much too wide.' A companion volume on electrical and electronic techniques, treated in a similar way, would be equally helpful. Nevertheless this is a useful reference book to have on the shelf in any laboratory.

R. C. CHIRNSIDE

INTRODUCTION TO QUANTUM FIELD THEORY. F. Mandl. Pp. vii + 202. *New York: Interscience Publishers Inc.; London: Interscience Publishers Ltd*, 1959. 34*s*.

PRINCIPLES FOR BRITISH AGRICULTURAL POLICY. A study sponsored by the Nuffield Foundation. Edited by H. T. Williams. Pp. iii + 317. *Oxford: The University Press*, 1960. 18*s*.

ANNUAL REPORT OF THE INSTITUTE FOR MEDICAL RESEARCH FOR 1958. Federation of Malaya. Pp. v + 135. *Kuala Lumpur: Government Printer*, 1959. $2.50.

ANNUAL REPORT OF THE CAWTHRON INSTITUTE, 1958-59. Pp. 44. *Nelson, N.Z.: The Cawthron Institute*, 1959.

Institute Affairs

DIPLOMA EXAMINATIONS

Examinations for Postgraduate Diplomas in Applied Chemistry will be held in the autumn in London or elsewhere at the discretion of the Council. The examination in Branch E will be held in the week beginning **Monday, 3 October, 1960.** The dates of the examinations in other branches have not yet been confirmed, but will be at about the same time. Candidates for these examinations should return completed application forms to the Institute not later than **Friday, 15 July.** The last date for the receipt of Entry Forms is **Friday, 29 July.**

Organization of Committees, 1960-61.—At the meeting of the Council on 20 May, the dates and times of meetings of Committees that normally meet monthly were settled, and the Chairman and members of the various Committees of the Institute and the representatives on joint committees with other bodies were appointed. A complete list will be published next month, when revised schedules of Honorary Representatives in Universities, Liaison Officers in Technical Colleges and representatives on advisory committees and other organizations will also be available.

The general pattern of Institute Committees has not been altered but it has been agreed that matters arising from the Council's statement on 'Possible new grade of membership and category of affiliation' (*J.*, 122) will be referred to the re-constituted Study Group on Qualifications, thus leaving the Professional Status Committee free to deal with its more normal business.

British Standards Institution.—The Council has nominated Dr R. S. Cahn to succeed the late Sir Alfred Egerton as representative of the Institute on the B.S.I. Units and Symbols Standards Committee, USM/-; and Dr D. J. Webley, in place of Mr R. I. Savage (resigned), on Technical Committee LBC/1 and its sub-committees LBC/1/4 and LBC/1/5, concerned with Laboratory Glassware.

Humphry Davy Lecture.—Professor V. N. Kondratiev, Member of the U.S.S.R. Academy of Sciences, has agreed to give the Second Humphry Davy Lecture at the Royal Institution, 21 Albemarle Street, London, W.1, on Wednesday, 12 October at 7 p.m. The title of the address will be 'Energy Exchange in the Interaction of Particles under Electric Discharge.' Light refreshments will be available from 6.30 to 7 p.m.

Liaison Officers Conference.—The third national Conference of Liaison Officers in technical colleges will be held at Queen Elizabeth College, London, on

Saturday, 2 July. A major item for discussion this year will be the recent Council statement on a possible new grade of membership and category of affiliation.

The Ministry of Education is organizing a Conference of heads of departments of chemistry in technical colleges on the previous afternoon, 1 July. This will be held at The Polytechnic, Regent Street, W.1.

These two conferences will provide a valuable opportunity for heads of departments and senior staff responsible for chemistry courses in technical colleges to discuss matters of mutual interest with the Ministry and the Institute on successive days.

National Certificates: Supplements to Rules 100.—The Joint Committee for England and Wales has authorized the issue of two 'Supplements' giving more detailed suggestions on certain aspects of National Certificate schemes than are contained in the 'Notes for Guidance' (*Rules* 100, revised 1958).

The Supplements are based largely on experience gained from the assessment and inspection of approved schemes and are intended to indicate some of the best current practice. Others will be issued on occasion in order to draw attention to desirable trends in the evolution of schemes, and they are likely to be of general interest to all teachers of chemistry.

Supplement No. 1. 'The structure and content of National Certificate schemes in Chemistry and Applied Chemistry.'

Supplement No. 2. 'The assessment of a student's practical inorganic chemistry, with special reference to analysis.'

Copies (gratis) may be obtained from the Secretary of the Joint Committee at 30, Russell Square, W.C.1.

Summer School in Analytical Chemistry—Advance Notice.—The next Summer School in Analytical Chemistry will be held at the Manchester College of Science and Technology from 9 to 15 September, 1962. Although the fifth Summer School, this will be the first to have been held outside London. The Summer School in Analytical Chemistry originated as a London Section event in 1950 but on the last two occasions it has become a function of such size and complexity that Council has been directly responsible for the organization, through an Executive Committee. The 1962 Summer School will again be organized by an Executive Committee, responsible to the Council; as on previous occasions, the Society for Analytical Chemistry will have representatives on the organizing Committee.

Institute Representative.—Mr A. J. Turnbull, *Fellow*, has been appointed as Institute representative on the Governing Body of the Hackney Technical College in succession to Mr L. M. Miall.

PERSONAL NOTES

Honours and Awards

Dr C. J. T. Cronshaw, *Fellow*, has been awarded the Hinchley Medal of the British Association of Chemists for his great services to the chemical industry while head of Imperial Chemical Industries Ltd, Dyestuffs Division.

Sir Cyril Hinshelwood, O.M., P.R.S., *Fellow*, will receive the honorary degree of Doctor of Civil Law on 22 June at the hands of the Prime Minister who as Chancellor of the University of Oxford will preside at his first Encaenia in the Sheldonian Theatre.

Professor R. L. Wain, F.R.S., *Fellow*, professor of agricultural chemistry at Wye College, Kent, has been awarded the research medal of the Royal Agricultural Society of England.

Societies and Institutions

Dr J. G. Davis, *Fellow*, was re-elected Chairman of the Association of Consulting Scientists at the annual meeting held in London recently.

Sir Patrick Linstead, C.B.E., F.R.S., *Fellow*, *Meldola Medallist*, has been appointed to Honorary Membership of the Institution of Mining and Metallurgy in recognition of his services to the profession of mining and metallurgical engineering in the field of education.

Dr R. S. Marriott, *Fellow*, was elected an Honorary Member of the Society of Cosmetic Chemists of Great Britain at a Special General Meeting held on 7 April.

Dr H. L. Richardson, *Fellow*, head of the Overseas Department, Imperial Chemical Industries Ltd, Central Agricultural Control, was elected President of the Fertilizer Society at the Society's 13th A.G.M. on 19 May.

Mr S. D. Sutton, *Fellow*, was elected Chairman of the British Seamless Rubber and Plastics Manufacturers' Association at the A.G.M. held in London on 19 May.

Dr D. E. Wheeler, *Fellow*, managing director of the Wellcome Foundation Ltd, was elected vice-president of the Association of British Pharmaceutical Industry at the annual meeting of the council on 27 April.

Educational

Mr C. P. Falshaw, *Associate*, has relinquished his appointment with St Anne's Board Mill Co. Ltd, Bristol, to take up an Imperial Tobacco Company Research Fellowship in the department of organic chemistry, University of Nottingham.

Dr Alfred Gottschalk, *Fellow*, of the Australian National University, Canberra, is visiting the U.S.A. and the Continent until 10 August. He will be in England at the beginning of July.

Dr D. P. Graddon, *Fellow*, formerly a senior lecturer at Birkenhead Technical College, has been appointed to the staff of the department of inorganic chemistry, University of New South Wales.

Mr J. R. Handford, *Associate*, has recently been appointed lecturer in chemistry at St Peter's College, Saltley, Birmingham.

Professor S. S. Israelstam, *Fellow*, associate professor of chemistry, University of the Witwatersrand, has been re-elected President of Convocation of the university for a further two years.

Dr R. E. Johnstone, *Fellow*, assistant technical manager, Springfield Works, U.K.A.E.A., has been elected by the Council of the University of Nottingham to be the first holder of the Lady Trent Chair of Chemical Engineering.

Dr Kiang Ai Kim, *Fellow*, of the University of Malaya, has been appointed to the Chair of Chemistry in succession to Dr R. A. Robinson.

Dr S. Neelakantan, *Associate*, has returned from Rutgers University, New Brunswick, U.S.A., to the department of chemistry, University of Delhi.

Dr R. L. Sykes, *Fellow*, has relinquished his post with the South African Leather Industries Research Institute to take up an appointment as senior lecturer and head of the science department at the National Leathersellers College in London.

Dr H. R. Thirsk, *Fellow*, formerly senior lecturer in chemistry, King's College, University of Durham, Newcastle upon Tyne, has been appointed Reader in electrochemistry in the same university.

Public and Industrial

Mr F. E. Arnold, *Associate*, has relinquished his post with Prices (Bromborough) Ltd, to take up an appointment with E. S. & A. Robinson (Holdings) Ltd, Bristol.

Dr J. Legett Bailey, *Associate*, formerly of the Rowett Research Institute, Aberdeen, has been appointed to the Biochemistry Section of Twyford Laboratories Ltd.

Mr N. W. Berry, *Associate*, has relinquished his post with John & E. Sturge Ltd, to take up an appointment as senior production chemist, Allen and Hanburys Ltd, Ware.

Mr C. G. Childs, *Associate*, technical manager of Bowmans Chemicals Ltd, has been appointed a director.

Dr R. A. E. Galley, *Fellow*, has resigned from his position as director of the Tropical Products Institute to take up an appointment with the Shell group as research director and manager of the Woodstock Agricultural Research Centre at Sittingbourne, Kent.

Mr M. Gaul, *Fellow*, has left Aden to join the Iranian Oil Refining Co. Ltd, Abadan.

The Earl of Halsbury, *Fellow*, with the approval of H.M. The Queen, has been appointed a governor of the B.B.C. until June, 1962.

Mr W. D. B. Hamilton, *Associate*, has left Marischal College, Aberdeen, to take up an appointment as chief chemist, British Egg Marketing Board.

Mr P. K. Hanley, *Associate*, has relinquished his post with Imperial Chemical Industries Ltd, Billingham Division, to take up an appointment as research officer at the headquarters of the Soils Division, the Agric tural Research Institute of Ireland, Johnstown Cas Wexford.

Mr E. S. Hiscocks, *Fellow*, director of the U Scientific Mission in Washington, has been appoin director of the Tropical Products Institute in success to Dr R. A. E. Galley, *q.v.*

Mr Bernard F. Howard, J.P., *Fellow*, has resig from the Board of Howards & Sons Ltd, and has b elected President of the Company. Mr Howard, w is 80, has been a director for 57 years. Mr How has served the Institute as a Member of Council, Vi President and Treasurer.

Mr F. T. Knight, *Associate*, works manager, Al Glass Ltd, a subsidiary of United Glass Ltd, has b elected a director of the company.

Dr V. A. Knivett, *Associate*, formerly of the Mic biological Section of the National Chemical Laborat (D.S.I.R.) has been appointed to the Microbiol Section of Twyford Laboratories Ltd.

Mr L. W. J. Loveless, *Associate*, has relinquished post with Courtaulds Limited, Coventry, to take up appointment with the Usutu Pulp Company Ltd, Johannesburg.

Mr P. J. Platt, *Fellow*, is now general works mana of Kemball Bishop & Co. Ltd, Bromley-by-Bow, Lond a member of the Pfizer group of companies.

Mr G. F. Prescott, *Associate*, works manager, Plas Group, Distillers Co. Ltd, has been appointed a direc of British Resin Products.

Dr K. W. Richmond, *Fellow*, has been appoin to manage the Commercial Investigation Departmen the Witco Chemical Company's Research and Devel ment Group, with a view to expanding Witco's ma facturing operations in Europe.

Mr G. H. Rostron, *Associate*, has left this country take up an appointment with Unilever N.V., Rotterda

Dr James Taylor, M.B.E., *Fellow*, has been appoin chairman of Almin Ltd, the parent company of Associated Light Metal Industries Group, recen acquired by Imperial Chemical Industries Ltd a the Aluminium Company of America.

Dr R. C. M. Thakkar, *Associate*, recently resigned position as head, chemicals development, Un Carbide (India) Ltd, and has joined Industrial a Allied Chemicals of Bombay as a director.

Mr A. F. Thomson, *Associate*, has been appoin senior development chemist at the Resistors Laborato The Plessey Co. Ltd, Swindon.

Mr Bryan Topley, *Fellow*, of Albright & Wilson L has been elected deputy chairman of the board directors.

Dr J. H. Towler, *Associate*, has recently been appoin Area Chief Chemist to the North Eastern Gas Boa

Mr W. H. Whittaker, *Associate*, has taken up appointment as chief chemist to Phillip's Carbon Bla (Pty) Ltd, South Africa.

Section Activities

Birmingham and Midlands

Advances in Fatty-Acid Chemistry. On 17 March Dr F. D. Gunstone gave a lecture on some advances in fatty-acid chemistry during the last decade. Dr Gunstone reviewed three advances: the structure of natural fatty acids, methods of synthesizing fatty acids, and chromatographic methods of studying fatty-acid mixtures.

Most of the new acids isolated and characterized during the 1950s fall into four groups. Several polyunsaturated acids of conventional type, containing an even number of carbon atoms per molecule and having successive olefinic groups separated by one methylene group, have been obtained, chiefly from fish triglycerides and from animal phospholipids. These acids are mainly of the 'oleic,' 'linoleic' or 'linolenic' type (Klenk). The recognition of a hydroxy acid isomeric with ricinoleic acid led to the reinvestigation of a number of seed oils, with the discovery of a series of epoxy acids, of which four have now been characterized. New acids having conjugated unsaturation have also been reported: these frequently contain acetylenic linkages and are sometimes accompanied by hydroxy acids. Finally, a group of unusual acids contain a cyclopropane or cyclopropene ring system.

Of the synthetic routes to unsaturated acids developed in recent years, that involving the use of acetylene compounds is the most flexible. The usefulness of acetylene compounds resides in their ability to form metallic derivatives that undergo condensation reactions resulting in oxidative coupling, and selective and stereospecifical reduction. The application of these reactions has led during the past decade to the synthesis of many mono-, di- and tri-ethenoid acids and culminated last year in the synthesis of tri-, tetra- and penta-ethenoid acids of biochemical interest in the study of arteriosclerosis.

The qualitative and quantitative study of fatty-acid mixtures, which has always been important in lipid studies, has been revolutionized during recent years by the application of two chromatographic techniques to this problem. Reversed-phase partition chromatography, first introduced by Howard and Martin (1950) and requiring no elaborate or expensive apparatus, has been developed into a valuable technique for separating and analysing fatty-acid mixtures. The stationary phase is usually paraffin held on kieselguhr, treated with dichlorodimethylsilane as inert support, whilst the mobile phase is aqueous acetone. Different fatty acids are eluted from the column with different concentrations of aqueous acetone, the elution being followed by titration with alkali. Unsaturated acids run with lower saturated acids (*e.g.* oleic with palmitic, or linoleic with myristic) but the composition of a mixture of acids is readily determined from chromatograms of the acid mixture—alone, after hydrogenation and after ozonolysis.

Gas–liquid chromatography is even more convenient, in that results are obtained on less material and in less time. The mobile phase is an inert gas such as nitrogen or helium or argon and the stationary phase is most generally an Apiezon grease or a polyester. From two chromatograms run with these different stationary phases it is usually possible to determine the composition of even the most complex mixture of fatty acids. The results have already indicated that the mixture of fatty acids derived from liquids, especially of animal origin, is more complex, and more interesting, than was recognized hitherto. Recent developments make it possible to indicate the chain length and degree of unsaturation of an unknown acid from its position on two chromatograms.

Annual General Meeting. The A.G.M. of the Section was held at the College of Advanced Technology, Birmingham, on 30 March. The Minutes of the previous Annual General Meeting, the Committee's Report for 1959, and the Financial Statement for the year ending 30 September, 1959, were approved.

The following Officers and Members of Committee were elected for the ensuing year: Chairman, Mr G. King; Vice-Chairman, Mr S. A. Ray; Hon. Treasurer, Dr M. Williams; Hon. Secretary, Dr J. E. Gregory; Members of Committee, Professor J. C. Robb, Drs M. E. Foss, P. A. Ongley, E. Tidd and W. Wilson (District Member of Council), Messrs K. A. Hyde, E. G. K. Pritchett (Immediate Past Chairman), R. C. Rooney and L. H. Vaughan. Messrs A. Argyle and G. Barnett were re-elected Hon. Auditors.

Mr N. W. Knewstubb proposed a vote of thanks to the retiring officers, making special mention of Mr R. D. Burn who relinquished the office of Hon. Treasurer, and Mr E. M. Joiner who ceased to be a member of the Committee after serving on it continuously for over 20 years, and the proposition was carried with acclamation.

Visit to Corby. On 6 April the Section accepted an invitation from Messrs Stewart and Lloyds to visit their works at Corby. After spending most of the day inspecting this very modern steel plant a meeting was held at the College of Technology, Northampton, at which Professor G. F. J. Garlick, of the University of Hull, lectured on 'Some Physico-chemical Problems in Semiconductor Physics.' It is hoped to print a summary of this lecture in a later issue.

Cardiff and District

Ladies' Evening. This most successful gathering of the season, held at the Royal Hotel, Cardiff, on 25 February, was arranged by the local section of the Society of Chemical Industry and made possible by the

very generous display organized by British Nylon Spinners. The evening's programme was opened by the chairman, Mr P. J. C. Haywood, who addressed the large and ever-increasing numbers of members, their wives and daughters, and outlined the pleasures that awaited them. The gathering then flowed into the buffet and afterwards streamed around the splendid scientific demonstration, showing processing of nylon yarn as well as the latest additions to the nylon range including the dazzling nylon-sparkle material. The ladies displayed a mildly sceptical interest in the scientific apparatus and the various emulsions in an array of glass containers, and if husbands were interested in substituted side-chains, the questions asked by their wives were strictly utilitarian, and referred more to 'ladders' than to chain-polymerization.

The fashion show was announced to begin at 8.30, but seats along the mannequin's 'cat-walk' were filled to capacity soon after 8 o'clock, and at 8.20 a perspiring team of stewards ranged the hotel in company with aggrieved porters in search of more chairs to seat those who continued to pour into the space surrounding an anxious pianist whose view of his artistes was in danger of being completely cut off.

The lady announcer's voice over the loudspeaker system was a model of clarity and described to an audience, hushed in expectation, the spectacle before them in terms foreign to the scientists, but readily understood by the ladies.

The spectacle opened with a selection of nylon lingerie, knit and jersey wear, all of which had been first displayed by the same expert mannequins at the Nylon Trades Fair held in London a few days previously. The highlight of the show was a range of evening dresses in different nylon materials designed by six of Britain's top designers, including Norman Hartnell, Ronald Paterson and Victor Stiebel.

The audience responded with enthusiasm to the votes of thanks proposed by Mr Warren. Dr Lodge replied on behalf of British Nylon Spinners.

Annual Dinner and Dance. The tenth Annual Dinner and Dance, held jointly with local members of the Society of Chemical Industry was held on 25 March at the Monkstone Club, Rumney, Cardiff, and was attended by about 60 members and friends. After an excellent dinner, the guests sorted themselves out, the more active ones joining in with the young folk on the dance floor.

Left to right. Mrs Rout, Mr P. J. C. Haywood, Mrs. Haywood, Mr H. K. B. Rout

There were endless conversation, photographs, anecdotes and much laughter, all contributing to a very happy social occasion.

EAST ANGLIA

Recent Trends in Volumetric Analysis. Mr D. E. Herring of E. R. Howard Ltd, gave a talk on 'A Survey of Recent Trends in Volumetric Analysis,' on 3 March at the Fox Hotel, Stowmarket. Mr Cyril Hall took the Chair. He dealt with three main fields of recent development: (*a*) chelometric titrations; (*b*) titrations in non-aqueous solution; and (*c*) two-phase titrations.

In chelometric titration, the chief reagent used is EDTA. By varying pH and indicator and also by the use of masking agents, this reagent can be used to estimate a wide variety of metals either alone or, in some cases, in mixtures. Mr Herring gave his opinion as to the efficacy of some of the indicators and masking agents available and demonstrated the use of EDTA to estimate zinc and aluminium in admixture using zincon as an indicator and triethanolamine to mask the aluminium. He emphasized that this was a demonstration of technique rather than of a practical method.

Mr Herring then went on to survey a large number of titrations in non-aqueous solutions, such as acid–alkali titrations in basic, acidic or neutral solvents,

Karl Fischer estimations and precipitation titrations. He gave examples of practical applications of each.

Finally Mr Herring gave instances of the use of two-phase systems for the titration of surface-active materials, *e.g.* anionic detergents in cloth, with C.T.A.B. as reagent and a mixture of Dimidium Bromide and Disulphine Blue VN as indicator, the partition being between water and chloroform. This technique was demonstrated.

After a discussion, Mr H. F. Bamford proposed the vote of thanks.

Forensic Science. The last meeting of the Session was the first to be held in Colchester. Dr I. G. Holden of the Metropolitan Police Laboratory spoke, under the Chairmanship of Dr E. C. Wood, on 'Forensic Science.'

He began by sketching the history and organization of the Metropolitan Police Laboratory and indicating the type of work carried out there. Seven scientific officers and auxiliary staff deal with approximately 2,500 cases a year, entailing up to 200 court appearances by each scientific officer.

Normally the samples or exhibits are assembled by the police officer in charge of the case, who collects a large number of control samples at the scene of the crime for comparison later with any available samples found in the suspect's possession.

A typical case of breaking and entering may involve comparisons of glass, paint, jemmy marks and scratches, safe ballast, explosives, hairs and fibres from the scene of the crime with traces found on the suspect's clothes, and so on. Much of the examination is physical, in order to avoid destroying samples. Glass may be compared in refractive index and density; paint in the number and thickness of layers of various colours, together with solvent and spectrographic tests. Safe ballast is normally examined microscopically.

The talk was entertainingly illustrated with anecdotes from the speaker's experience, and was thoroughly enjoyed by those present.

After a long discussion, Mr E. H. Coulson proposed the vote of thanks.

EAST MIDLANDS

Annual General Meeting. The Section's A.G.M. was held at Nottingham on 24 March. The following officers were elected: Chairman, Mr G. Oldham; Vice-Chairman, Mr E. R. Pike; Council Member, Mr L. P. Priestley; Hon. Recorder, Dr R. F. Phillips; Hon. Secretary, Mr R. W. Hale. Dr T. A. Elliott was elected Hon. Auditor. Mr E. R. Pike was thanked for valuable services as Hon. Secretary during the year.

After the meeting a lecture was given by Dr B. W. Langley on 'Cancer Research.' Having reviewed the present mortality rate from cancer in relation to other diseases, Dr Langley outlined the current treatments and their defects and spoke of the need for an effective cancer chemotherapy. Laboratory methods of testing anti-cancer agents were outlined. The compounds which have thus far been of greatest clinical value are the alkylating or radiomimetic agents. The lecturer discussed the history and supposed mode of action of these compounds and described some of the more recent members of this class.

The speaker, however, was particularly interested in antimetabolites. After introducing the antimetabolite hypothesis and its application to other fields of chemotherapy he mentioned how purine, pyrimidine and folic acid antagonists had been used in cancer treatment and outlined some of the latest developments in this work. The lecture was illustrated with a film, 'From One Cell,' made by the American Cancer Society. Mr F. R. Mumford proposed the vote of thanks.

EDINBURGH AND EAST OF SCOTLAND

Christmas Lectures. A large number of senior secondary school-children attended the 1959 Christmas Lectures on 'Light and Colour in the Sky and Landscape' given by Mr James Paton, of the Department of Natural Philosophy on 29 and 30 December. The lectures, which were well illustrated, were appreciatively received by the audience, which included a number of teachers. Mr Paton is a world-renowned authority on the 'Aurora' and he communicated his enthusiasm for this subject to his audience.

Criminal Investigation. Detective Superintendent J. K. McLellan delivered a lecture entitled 'Chemistry applied to Criminal Investigation' to an unusually large audience of about 130 members and guests at a joint meeting of the local sections on 8 January. Mr McLellan traced the development of the laboratory maintained by the Glasgow Police and extensively reviewed the various types of investigations with which it had been concerned in recent years. A large and varied assortment of exhibits amply illustrated this most interesting and humorous lecture.

After a general discussion Dr W. M. Ames was warmly supported by the meeting in proposing the vote of thanks.

Annual Dinner. Professor E. L. Hirst, C.B.E., F.R.S., took the Chair at the Joint Annual Dinner of the local sections held in Adam House on 15 January. Sir William Ogg, the principal guest, proposed the toast to the 'Three Chemical Societies' in a most entertaining speech. After replying on behalf of the three societies, Professor Hirst paid tribute to the work done by Mr J. K. Fleming, secretary of the local section of the S.C.I., who organized the function.

Reaction Mechanisms. On 2 February, Professor E. D. Hughes, F.R.S., addressed a joint meeting with the other chemical societies and with the University of Edinburgh Chemical Society on the subject of 'Reaction Mechanisms.'

In his lecture Professor Hughes discussed the methods employed for the elucidation of the mechanisms of

classical reactions in organic chemistry with particular reference to substitution, addition, elimination and rearrangement processes.

After a short discussion the vote of thanks was proposed by Mr R. L. S. Patterson, Vice-President of the E.U.C.S.

Food Science. 'The Concept of Food Science' was the title of a paper delivered by Professor J. Hawthorn to a joint meeting with the Food Group of the Society of Chemical Industry on 18 February. After briefly surveying the history of the development of food processing, Professor Hawthorn discussed some of the consequences of population pressure on world food supplies. By reference to current food processing problems he illustrated the basic training required by a food scientist and stressed the importance of a sound basis of physics, chemistry, biochemistry and microbiology in this training.

After a lively discussion Dr A. E. Bender proposed the vote of thanks.

Committee Meeting. At a meeting of the Committee held on 11 February, the following Officers were elected for the year 1960-61: Chairman, Mr G. W. Walker; Vice-Chairman, Dr E. A. C. Chamberlain; Hon. Recorder, Dr H. C. Oldland; Hon. Secretary-Treasurer, Mr K. A. Scott, Department of Pharmacology, University New Buildings, Teviot Place, Edinburgh, 8.

GLASGOW AND WEST OF SCOTLAND

Stonehenge. At a well-attended meeting of the Section on 12 February in the Royal College of Science and Technology, Glasgow, Professor Stuart Piggott gave a lecture on 'Stonehenge in the light of Modern Knowledge.' Dr W. A. Caldwell was in the Chair.

Professor Piggott described how the excavations carried out on the monument of Stonehenge between 1950 and 1959, taken in conjunction with the results of earlier work on the site, showed that it began as a circular sanctuary enclosed by a bank and ditch and containing a circle of ritual pits, to be dated *ca* 2000 B.C. It was followed by an unfinished double circle of 'Blue Stones' brought from Pembrokeshire, and this was in turn dismantled, some of the stones being later incorporated in the main structure of the third phase of dressed uprights and lintels made of stones from North Wiltshire. In a final rearrangement all the 'Blue Stones' were used (around 1500 B.C.) in the monument which, apart from later ruin, stands today.

The ensuing discussion showed the keen interest of the audience, which included members of the Glasgow Archaeological Society.

Professor Hugh Nicol proposed the vote of thanks.

Annual General Meeting. The 41st A.G.M. of the Section was held on 11 March in the Royal College of Science and Technology, Glasgow. The following Officers and Members of Committee were elected: Chairman, Dr W. A. Caldwell; Vice-Chairman, Professor P. D. Ritchie; Hon. Secretary, Dr W. Gibb; Hon. Treasurer, Dr A. C. Syme; Members of Committee: Professor P. L. Pauson and Mr P. Birrell. The other Officer and Members of Committee are: Hon. Assistant Secretary, Dr W. D. Williams; Members of Committee: Professors J. N. Davidson and R. A. Raphael, Dr E. R. Inman, Detective Superintendent J. K. McLellan and Mr J. W. Murfin. The District Member of Council is Professor Ritchie.

After the business meeting, members and their guests were entertained with a programme of scientific films. The films were: *Station* 307, which describes the geological examination of the sea-bed of the Persian Gulf carried out by a team of geologists and aqua-lung divers, led by Capitaine Cousteau. *West Coast Cargo* is a colour film expressing the contemporary activity of the Nobel Division of I.C.I. Ltd, its plants, processes and people. The manufacture of blasting explosives, detonators and safety fuse by modern techniques was shown, together with the Division's chemical products: pentaerythritol, cellulose derivatives and silicones. *Forming of Metals* shows in colour the processes of rolling, forging, drawing, extrusion and pressing in remarkable detail. Finally, another colour film, *More Power from the Atom*, carries the story of nuclear power in Britain forward from the completion of Calder Hall. It includes construction work at the power stations being built for the electricity authorities, and work on more advanced reactors with the Atomic Energy Authority.

HUDDERSFIELD

Paper Chromatography of Dyestuffs. On 8 March a lecture was given on this subject by Mr J. C. Brown of Ciba Clayton Limited, Manchester. Mr G. H. Binns, Chairman of the Huddersfield section of the society of Dyers and Colourists was in the Chair.

Mr Brown outlined the scope of chromatography in general and showed how the different classes of adsorption, partition and ion-exchange chromatography were represented in column and paper techniques. The methods adopted for descending and ascending paper chromatography were then discussed before passing to specific examples of dyestuffs chromatography.

The lecturer outlined methods for handling acid, direct cotton, disperse and 2:1 metal-complex dyestuffs, some of which were completely new. For example, a system of inverse phase-partition chromatography on silicone-treated paper was shown to be excellent for disperse dyestuffs.

The paper chromatography of direct dyestuffs, hitherto thought to be impractical because of the high affinity of these dyestuffs for cellulose, was shown to be possible with eluent mixtures based on dimethylformamide. Attention was paid to methods of extracting dyestuffs from textile fibres and some of the complicated results obtained, say with direct dyestuffs, were shown to be directly related to the methods of manufacture.

The vote of thanks was proposed by Dr W. B. Waddington.

Annual General Meeting. The A.G.M. of the Section was held on 25 March at 32, John William Street, with Dr E. Tittensor presiding. The reports of the Hon. Secretary and the Hon. Treasurer were adopted. It was noted that the attendance of members at meetings during the session had been maintained at a reasonably satisfactory level, recently revised Section Rules had been issued, and a Postal Referendum, sent to all members of the Section, had produced a sixty per cent response. The Chairman reviewed the results of the referendum, and concluded that they would assist the Section Committee in formulating plans for the next session.

Dr R. R. Pritchard retired from the office of Hon. Secretary, and Mr F. W. Jarvis was elected. Messrs C. V. Hockey and R. F. J. Gross, Members of Committee, who were retiring, were warmly thanked for their services, and Messrs G. M. Harrison and E. Priestley were elected. Dr H. H. Goldthorpe kindly agreed to serve again as Hon. Auditor.

Physical Chemistry in the Organic Chemicals Industry. After the A.G.M., Dr D. S. Davies, of Imperial Chemical Industries Limited, General Chemicals Division, delivered a lecture on 'Physical Chemistry in the Organic Chemicals Industry.'

The speaker said that his intention was to ask whether contributions from the world of ideas—theoretical and physical chemistry—really made a substantial economic contribution to the invention, manufacture and development of chemicals. He described briefly findings on the structural requirements for radical-capture agents and the use of this information in anti-oxidant and monomer-processing technology; he discussed the more complete picture of isomer distribution now emerging from the notion that less active reagents gave more specific isomer distribution. Other topics were Zollinger's complete picture of azo-coupling, and contributions of dyeing theory to solving problems of dyeing nylon and Terylene.

Such work was not always directly justified financially, but it often helped, in an unexpected way, to solve apparently unrelated problems. Thus proposals to investigate the interactions of neutron and heavy elements would not have seemed financially justifiable in 1934. The degree of economic hard-headedness desirable in research planning and management was therefore extremely difficult to define.

After a lively discussion, the lecturer was thanked by Dr W. R. H. Hurtley.

HULL AND DISTRICT

Fibres, Dyes and Dyeing. On 31 March, Dr R. L. Elliott, Bradford Institute of Technology, gave a lecture at the North Lindsey Technical College, Scunthorpe, on the subject of fibres, dyes and dyeing.

Dr Elliott began by dividing fibres into certain well-defined groups and comparing the world usage figures over the last 50 years. The chemistry of the various fibres was covered and physical properties discussed. The importance of crystalline fraction to non-crystalline in the individual fibres was mentioned with regard to the effect upon physical properties. It became clear that the chemistry of fibres has reached the stage where it is now possible to tailor molecules to get desired properties.

The chemistry of those natural dyes chemically related to certain synthetic dyes was rapidly covered and a brief survey given of modifications of molecules to give special fastness properties. The stereochemistry of the dye molecules was stressed, with particular attention to the effect on dye substantivity for cellulosic fibres. The latest 'reactive dyes' were dealt with in some detail as regards their mode of reaction with cellulose.

The many methods of dye application were reviewed and the effect of temperature in obtaining satisfactory results was discussed both for synthetic and natural fibres.

The lecture was illustrated with many slides, together with a film on the reactive Cibacron dyes kindly loaned by Ciba-Clayton Ltd. The Chairman for the evening was Dr T. S. Harrison, and the vote of thanks was proposed by Mr P. Bricklebank.

LEEDS AREA

Stereochemistry and the Stability of Metal Complexes. A meeting was held on 14 March at the Bradford Institute of Technology. Mr R. K. K. Fourness was in the Chair, and Dr E. J. C. Rossotti gave a lecture on 'Stereochemistry and the Stability of Metal Complexes.'

After outlining the nature of metal ions, ligands and their interactions in solution, the lecturer illustrated the principle of stepwise equilibrium and described methods of determining formation constants. The magnitude of stepwise stability constants for the series of complexes formed by a given metal ion and a number of identical ligands usually decreases regularly, due to a combination of statistical, electrostatic and steric effects. Abnormal sequences accompany changes in the hybridized orbitals used in the metal–ligand bonds.

The stability of complexes of a particular ligand usually increases as the size of the cation decreases for the lanthanides, actinides and metal ions of Groups IA, IIA and IIIA. A superimposed ligand field-stabilization energy produces the Irving–Williams sequence for cations in the first transition series.

The importance of mutual compatibility of the preferred stereochemistry of both metal ion and ligand was illustrated with reference to polyamines. Chelates are more stable than analogous complexes with unidentate ligands. Absence of this 'chelate effect' may be due to ring-strain, or to the failure of a donor atom to

coordinate the metal ion. The stability of analogous chelates decreases with increasing ring size and increases with the number of chelate rings. The role of the metal ion as Lewis acid is emphasized by relationships between stability constants and acid dissociation constants. Major deviations from these correlations are often due to steric hindrance.

The lecturer concluded by illustrating the application of the above approach to the understanding of chromatographic, ion-exchange and solvent-extraction separations, and to the construction of selective reagents for metal ions.

Many members contributed to the ensuing discussion, which clearly showed that much interest had been aroused. Dr E. G. Edwards, Principal of the Bradford Institute of Technology, thanked Dr Rossotti for a fascinating lecture.

LONDON

Colour Reproduction. A joint meeting with the Maidstone Camera Club was held on 8 December, 1959, at the Old Palace, Maidstone. The Chairman, Mr J. R. Barr, said he was pleased to welcome members of both bodies to the first meeting to be held in Maidstone, and then introduced the speaker, Dr H. Baines.

He began by pointing out that, as recently as 1801, the only radiant energy in the whole of the electromagnetic spectrum recognized by man was light, and discussed the reasons why the human eye confines its reception to less than an octave.

In some respects the eye is less sensitive than the ear, in that a mixture of wave-lengths cannot be distinguished from a single wave-length. With the aid of analysing filters identical colours were shown, one being monochromatic light and the other a band of about two-thirds of the spectrum. Experiments on which the trichromatic theory of vision are based were outlined.

Dr Baines briefly described and demonstrated the additive and subtractive methods of colour photography, and pointed out that such processes do not give a spectroscopic match with original colours, but match them by equivalent stimulation of the three colour receptors of the eye. For both additive and subtractive processes the ideal emulsion sensitivities and combined taking filters should simulate the sensitivities of the three receptors of the eye. This is difficult to achieve, but not impossible. For the additive process, each record should be projected using a filter which stimulates only one of the receptors and this is theoretically and practically impossible, even if one uses monochromatic filters. For the subtractive process, in which the ideal filters transmit two-thirds of the spectrum, the position is much worse.

Even with ideal dyes, there would be inevitable loss of saturation and shift of hue, but the best dyes available fall short of the ideal. In practice some loss of saturation is avoided by a greater separation of peak sensitivities of the three emulsions, compared with the sensitivities of the receptors of the eye. Transparencies were viewed in which the colour actually photographed was shown alongside the photographic result, and in the case of saturated colours the difference was quite marked.

Nevertheless, the results of a good reversal integral tripack colour material are very satisfactory, and the reasons for this were discussed. A transparency is seldom compared with the original, so that one is dependent for assessment on memory, which is very unreliable. Most viewers have never seen the original, so judge a transparency by what they think the original ought to have been. But any colour in an original will vary greatly with lighting conditions, and a reproduction which falls within this fairly wide range will be acceptable. Colour photography will thus give very pleasing pictures, but should not be regarded as an accurate instrument for scientific or technical purposes.

A lively and varied discussion followed, after which Mr G. H. Fellows, a member of the Camera Club, proposed the vote of thanks.

A Chemist's Thoughts on Chemotherapy. On 3 March, at West Ham College of Technology, Dr H. J. Barber gave a talk on 'A Chemist's Thoughts on Chemotherapy.' The Chair was taken by Mr A. J. Turnbull. In his introduction Dr Barber pointed out that the word 'chemotherapy' was not included in the *Shorter Oxford English Dictionary*, and only obscurely in the *Encyclopaedia Britannica*. He said that there was no precise definition of the term, but he preferred to extend its scope more than others might do.

Ehrlich's conception of the term was the treatment of disease caused by invading organisms, but the extension of the field of medicinal chemistry necessitated a broader outlook. After consideration of the types of attacking organisms, such as viruses, protozoa, bacteria and helminths, the conditions and situations in which drugs are used were indicated. The pioneers of the nineteenth century were Pasteur, who developed methods of culturing bacteria, and Koch and Ehrlich, who devised staining procedures. Ehrlich's genius flowered in the early part of the present century with the elucidation of the structure of Atoxyl and the great developments stemming from it. The syntheses of Plasmoquin and Atebrin were typical of the chemotherapeutic discoveries that followed. Meanwhile, in 1929, came Fleming's first observations on the antibacterial agent produced by penicillium mould. These passed almost unnoted at the time.

A new chapter in chemotherapy opened in 1935 with the use of sulphonamides, initiated by Domagk's work with Prontosil and followed by sulphapyridine, M & B 693, prepared by Ewins *et al.* in 1938—the first of a number of closely related 'sulpha' drugs. World War II stimulated further work on antimalarials, such as Paludrine (Curd & Rose, 1944). These led the lecturer to a discussion of the character of modern drug

research programmes involving the team-work of chemists, biologists and biochemists, and to the role of natural products such as quinine, morphine, cocaine, emetine and ephedrine as inspiration to the synthetic chemist. He noted that some of the therapeutic properties of ephedrine were known as long ago as 2760 B.C. through the use of extracts of the herb *Ma-huang*. As examples of very recent investigations, reference was made to the new trypanocidal drug metamidium which illustrated the unpredictability of structure/activity relationships, and the hypotensive drug, pempidine, which brought out the role of chance in shaping a chemotherapeutic investigation.

Turning to economic matters, the lecturer stated that the drug bill of the U.S.A. amounted to some £800m. per annum, with a research expenditure of £43m., Great Britain spending about one-tenth of this latter amount on investigational work. The Medical Research Council's £3m. to £4m. for research was only about one-twelfth of the Egg Marketing Board's annual subsidy.

Dr Barber closed by recommending the subject to young chemists as one which still held possibilities of individual discoveries. Members of the audience then joined in an interesting discussion over a wide range of topics, including the future treatment of viruses, resistant strains of bacteria and differences between human and animal behaviour towards drugs. The Principal of the College, Dr G. Bulmer, in thanking the lecturer and the R.I.C., referred to the development of liberal studies in technical colleges and cited Dr Barber's lecture as an excellent example of stimulating historical presentation.

Science in the Detection of Crime. An appreciative audience of 250 attended the lecture given at Hatfield Technical College on 8 March by Dr I. G. Holden. The Chair was taken by Mr F. C. Hymas.

Dr Holden began by indicating the extent and distribution of facilities for forensic science in the country and pointed out that these were only used in criminal law. The laboratory facilities were at the disposal of the defence as well as the prosecution, though they were rarely used by the former. There followed many interesting points about the history and present establishment of the service; for example, there are no pathologists—consultants are called in if necessary. After pointing out that seven officers have to deal with 2,500 cases a year, he said that only very rarely did they go to the scene of a crime, but that exhibits were brought to the laboratories for examination.

Dr Holden then took a typical case, and showed in detail the work of the scientist in this field—a fascinating half-hour of detail, precision and wit. After showing the order of probability which their methods could give, he gave some sound advice: 'so if you're thinking of doing it—don't.' This was followed by a complete miscellany of detail showing the many facets of the work of the laboratories, punctuated by amusing stories of plausible petty criminals inventing stories to outdo X-ray diffraction patterns, paper chromatograms and the like.

Dr Holden then showed, during the last 10 minutes, about a dozen colour slides—all well-chosen examples of the substance of his lecture, and followed this by answering a series of questions from the audience. The vote of thanks was proposed by Dr W. A. J. Chapman, Principal of the College.

Surface Chemistry. On 9 March a meeting was held jointly with the College Chemical Society at Chelsea College of Science and Technology. Mr P. A. Raine took the Chair and introduced the lecturer, Dr K. G. A. Pankhurst.

After considering soluble films, their methods of study and the application of the Gibbs adsorption isotherm, the lecturer dealt with insoluble films. He pointed out that the most fundamental work in this field was carried out in the years between the wars by the schools of Sir Eric Rideal and Professor N. K. Adam. In addition to the normal study of surface force–area relationships, Dr Pankhurst showed the important information obtained from a simultaneous study of the surface potential. This gives information about the homogeneity or otherwise of a film and also orientation of the film-forming molecules (dipoles). In conclusion the lecturer briefly reviewed the application of such film studies to surface reactions, including tanning.

Mr G. J. Gittens, Chairman of the College Chemical Society, proposed the vote of thanks.

MANCHESTER AND DISTRICT

Meeting with New Members. A meeting was held on 2 March in the Engineers Club in Manchester. Dr L. R. Ridgway welcomed new members on behalf of the Section. Previous activities of the Section were described by the Hon. Secretary and the Hon. Assistant Secretary and suggestions were invited from the audience. Members of the Committee then had the opportunity of informal discussions with new members during the serving of refreshments.

Some of the Newer Metals and their Application. Mr E. Foley spoke on this subject at a meeting held at the Technical College, Rochdale, on 9 March. The special needs of high-speed aircraft, guided missiles and nuclear energy have given an impetus to the extraction and preparation of hafnium, zirconium and vanadium. The lecturer surveyed the limitations of the older methods of separating hafnium from zirconium, including the fractional crystallization of ammonium fluorozirconate and fluorohafniate and the fractional precipitation of phosphates and oxalates. The more modern methods are by solvent extraction of the hafnium thiocyanate with methyl isobutyl ketone or the nitrate with tributyl phosphate. Mr Foley discussed the relative merits of column and mixer settlers.

The hafnium and zirconium metals are usually obtained by the Kroll method. An interesting technique for purification of the metals is by sublimation of the iodide on to a hot wire. This wire is heated by an electric current at a temperature such that the iodide decomposes, thereby releasing the pure metal and liberating iodine, which in turn is used to produce more iodide.

Mr Foley described the applications of these metals to the atomic energy industry. Zirconium alloys are used in water-cooled reactors and copper–molybdenum–zirconium alloys are used in carbon-dioxide-cooled reactors. The excellent resistance of these alloys to chemical attack in acidic and alkaline media indicate possible non-nuclear applications. The lecturer concluded his talk with a description of the methods of producing ductile vanadium and the use of tubing of this material in the Dounreay fast reactor.

Industrial Chemistry of the Lower Olefines. On 24 March, a conjoint Symposium on 'Industrial Chemistry of the Lower Olefines,' arranged with the Chemical Society, The Society of Chemical Industry and the Institute of Petroleum, and organized by the Institute of Petroleum, was held at the University of Manchester. The Chairman for the morning session was Professor F. Morton, who introduced the three speakers. Messrs J. Chrones and J. L. James of the Kellogg International Corporation presented a paper on 'The Economics of Ethylene Production from Light Naphtha.' Mr R. P. van Oosten of Bataafse Internationale Chemi Maatschappij gave an explicit account of 'The Production of Ethylene Oxide' by both the silver catalyst and chlorohydrin processes. With Professor R. N. Haszeldine in the chair, the afternoon session was divided into two sections. Dr A. F. Millidge of Distillers Co. Ltd, spoke on 'Industrial Chemicals based on Ethylene and Propylene' showing what a large range of simple intermediates originate from these two gases. Mr A. A. Appleton (Esso Petroleum Co. Ltd) then gave a paper on the 'Production and Utilization of Butadiene.' The evening session, under the Chairmanship of Professor G. Gee, C.B.E., F.R.S., was devoted to 'Newer Developments in the Polymerization of Olefines' which was the subject of the lecture given by Professor C. E. H. Bawn, C.B.E., F.R.S. The keen discussion that followed each of the five papers, and the high attendance, indicated the success of the Symposium.

Ladies' Evening. The Section held the Annual Ladies' Evening on 13 April at the Manchester College of Science and Technology. A large gathering of members and their wives listened to the very interesting lecture on fabrics by Mr Manogue of the Bradford Dyers' Association. The lecture was supported by a display of fabrics organized by the Colour, Design and Style Centre. After a buffet supper served in the refectory, two films were presented by the Cotton Board.

MID-SOUTHERN COUNTIES

Rubber Adhesives. On 9 March a meeting was held jointly with the Institution of the Rubber Industry at the Cathedral Hotel, Salisbury, and Mr H. J. Chard, Dunlop Rubber Co., spoke on 'Rubber Adhesives.'

The lecture was restricted to a consideration of solution-type adhesives. After a discussion on the theory of adhesion, a subject still not fully understood, the lecturer spoke on the physical nature of the surfaces to be joined, emphasizing that they should be thoroughly clean and smooth.

Different types of adhesives, including the natural-rubber based adhesives and the various synthetic adhesives, were next considered. The adhesion characteristics and uses of these types were discussed, and the lecture ended with an account of the part played by the physical nature of the various constituents of an adhesive. The lecture was illustrated with slides and Mr A. Williamson proposed the vote of thanks.

Antibiotics Research. On 17 March a meeting was held jointly with the Portsmouth Chemical and Pharmaceutical Societies at the Royal Beach Hotel, Southsea. The speaker was Dr M. Lamb of Boots Pure Drug Co. Ltd, who spoke on 'Recent Advances in Antibiotics Research.'

After some interesting statistics on antibiotics—some 5,000 active cultures exist from which about 1,000 antibiotics have been isolated as solids—the speaker gave a lucid and most fascinating account of the methods used in the search for new antibiotics, starting in the laboratory and progressing to large-scale production. The lecture was illustrated with slides.

Mr M. W. Northway proposed the vote of thanks.

Chemical Aids to Better Crops. On 24 March a meeting was held jointly with the Salisbury Field Club at the Cathedral Hotel, Salisbury. The speaker was Mr G. L. Baldit of Plant Protection Ltd who spoke on 'Chemical Aids to Better Crops.'

The lecture was concerned solely with pest destruction and the speaker dealt with both insecticides and weed killers. He outlined the history of the development of these two groups and the consequent alterations in methods of application of these chemical aids.

A series of coloured slides and a film were then shown illustrating various spraying techniques and showing the preparation of insecticidal mixtures from hexachlorocyclohexane.

The vote of thanks was proposed by Miss Stevens of the Salisbury Field Club.

NORTH WALES

English and the Scientist. A meeting was held at the Flintshire Technical College, Connah's Quay on 16 March when Mr A. L. Bacharach gave an illustrated

talk on 'English—the Scientist's Servant or Master or Both?'

Mr Bacharach began by disavowing any intention of trying to teach people how to write good English; the most, he said, that he could hope for would be that he might help some not to write bad English. He then discussed, under the headings of seven different extrinsic and intrinsic reasons, why he considered this a matter of some importance. During the rest of his hour's talk, he produced on slides many illustrations, both 'natural' and 'synthetic,' of how not to write and of how either to correct or to avoid error. These included some simple practical rules on such matters as when to use 'that' instead of 'which' as relative pronoun, how to know whether 'due to' should be replaced by 'owing to' and when to replace wrongly used conjunctions, such as 'while' and 'where.' He finally consoled his audience with two slides, under the title 'When Jove Nods,' illustrating grammatical or syntactical solecisms perpetrated by famous men or in journals of otherwise unimpeachable literary reputation.

A lively discussion followed and this enabled Mr Bacharach to elaborate some of his main points. Dr C. G. Lyons proposed the vote of thanks to the speaker.

TEES-SIDE

Organic Chemistry of Ferrocene. On 24 March Professor P. L. Pauson addressed a joint meeting with local members of the Chemical Society at Billingham on 'The Organic Chemistry of Ferrocene.'

Professor Pauson reviewed the discovery, nine years ago, of ferrocene (biscyclopentadienyliron) which was an unusually stable organometallic compound of an entirely new type. Intensive study in the field has resulted in the preparation of cyclopentadienyls of many other transition metals.

Preparative methods available for the synthesis of ferrocene and its derivatives include treatment of cyclopentadiene magnesium bromide with ferric chloride or reaction of cyclopentadiene in the vapour phase with iron or iron pentacarbonyl. The last method may also be used to obtain intermediate cyclopentadienylcarbonyl complexes of iron. Cyclopentadienyl alkali-metal compounds have also been used widely in the preparation of ferrocene derivatives.

Ferrocene undergoes many reactions typical of aromatic systems. The lecturer illustrated these with slides and also surveyed the general reactions of a large number of ferrocene derivatives.

The vote of thanks was proposed by Dr I. J. Faulkner.

THAMES VALLEY

Children's Lecture. The annual Children's Lecture was given by Dr D. W. Kent-Jones, past-President of the Institute, on 16 March, to a packed audience in the large chemistry theatre, the University of Reading. Dr Kent-Jones took as his subject 'Food' and traced its development in variety, nutritional value and methods of preservation from ancient times to the present day. The nutritional value of food, its composition, the role of vitamins and the desirability of enjoying food as distinct from merely consuming it were all discussed in the well-known 'K. J.' style and listened to with intentness and appreciation, as was evidenced by the number of good questions put to the speaker during question time. Dr P. F. Holt proposed the vote of thanks.

Film Evening. At a Film Evening on 25 March, a number of films were shown, including 'Building for Research,' 'The Vineyards and Wines of France,' 'Fundamentals of Fuel Knock,' 'Investigation Ipecac,' and 'Let's See,' the last-named dealing with the manufacture of optical glass and lenses. After the second film there was a break for refreshments and after the showing, Dr Grimbley thanked the projectionist and the University on behalf of the audience.

DECCAN

Annual General Meeting. The 10th A.G.M. of the Section was held on 13 February in the General Chemistry Lecture Hall of the Indian Institute of Science, Bangalore. The Chairman, Professor M. R. Aswathanarayana Rao, opened the proceedings by welcoming and introducing Mr V. K. Subramanian, General Manager of the Mysore Paper Mills Ltd, Bhadravati, who gave an address on the 'Paper Industry in India.'

In India the manufacture of paper was initiated by the Indian Muslims during the Moghul Period. Paper was then hand-made from materials such as gunny bags and rags. The first paper mill in the country was established in 1840. Subsequently a few mills were started, but they could not then compete with the cheaper and better imported paper. The Tariff Board in 1925 gave protection to the industry and thus facilitated its growth. Many mills were established, and now the annual production of paper is about 300,000 tons.

Although there has been a substantial improvement in the production of paper in the country, the consumption per head is only about 1·8 lb/year as compared with 405 in the United States, 200 in Great Britain, 145 in Germany, 5 in Ceylon and 2 in Pakistan. This may be partly attributable to the illiteracy in the country and the increase of population at the rate of 1·25 per cent per year. With the increase of the level of literacy at about 17 per cent, and with the proposed plans for rapid industrialization, the production of paper in India is expected to rise at a rate of nearly 10 per cent a year. It is envisaged that in the third Five-Year Plan the production of paper will reach 700,000 tons against the installed capacity of nearly 900,000 tons.

The chief raw materials for paper making in India are bamboo, sabi grass, bagasse, rags, waste paper and

wood pulp. Mr Subramanian then described the details of making paper from these raw materials, the types of machinery used, the varieties of paper made, production from the various mills, the installed capacity of new mills, market conditions, price controls, and related aspects. Dr B. H. Iyer proposed the vote of thanks.

After the lecture the business meeting took place, the minutes of the previous Annual General Meeting were read, and reports of the Hon. Secretary and Hon. Treasurer presented. The following Officers and Members of Committee were elected: Chairman, Professor M. R. Aswathanarayana Rao; Vice-Chairmen, Drs B. H. Iyer and C. Varadhan; Hon. Treasurer, Dr R. K. Maller; Hon. Secretary, Dr S. C. Pillai; Members of Committee, Professor P. S. Sarma, Drs B. N. Acharya, J. V. Bhat and G. S. Siddappa, Messrs B. N. Narayanaswamy, M. Rajagopalan, M. S. Rama Iyer and A. S. Venkateswara Rao. Mr R. Mallikarjunan and Dr S. Krishnamurthy were elected Hon. Auditors.

The proceedings for the evening concluded with a dinner at New Krishna Bhavan, Malleswaram, Bangalore.

EASTERN INDIA

Organization of Industrial Research in the U.K. A meeting was held on 2 February in the auditorium of the Bose Institute, Calcutta, when Dr N. Booth, Vice-President of the Institute and Managing Director of British Oxygen Research and Development Ltd (London), delivered a lecture on 'Organization of Industrial Research in the U.K.' Dr Booth was introduced by Dr N. K. Sen, Chairman of the Section.

Dr Booth, who brought with him good wishes and greetings from the President of the Institute to the Section, was pleased to have the opportunity of meeting members. At the beginning the lecturer gave an approximate idea of the diverse nature of the British industries, including the nationalized industries; he also discussed briefly the dimensions of various industries with special emphasis on the expenditure made by individual organizations on research and development. The lecturer then dwelt on the role of industrial and co-operative research on the development of an industry, and pointed out the significance of a critical examination of any future project for industrial development from the economic point of view prior to its adoption in the industry. Dr Booth further emphasized the importance of the management and organization of a big industrial establishment and finally gave a short history of this particular organization with special reference to the part played by research in its development. The lecture was illustrated with slides.

After a lively discussion, in which many members participated, Dr R. N. Chakraverti proposed the vote of thanks and requested him to convey the good wishes and greetings of the Section to the President and the Institute.

News and Notes

PRIZES AND AWARDS

Research Essay Competition.—In addition to the Waverley Gold Medal (*see* below), *Research* is this year introducing an additional competition under the title 'Application in Industry.'

Candidates must be practising scientists under 30 years of age and must submit an essay of some 5,000 words. The first prize is £50 and the second £30.

Further details are obtainable from the Editor, Research, 4/5 Bell Yard, London, W.C.2. The last date for entry is 31 July, 1960.

Waverley Gold Medal.—The Waverley Gold Medal Essay Competition sponsored by the journal *Research* is being organized for the 8th year in succession. The first prize will be the Medal and £100, and there will be a second prize and a special prize for a competitor under 30 years of age, each of £50. Further details may be obtained from the Editor, Research, 4/5 Bell Yard, London, W.C.2, and the last date for entries is 31 July, 1960.

SCIENTIFIC SOCIETIES

Institute of Chemistry of Ireland.—The Officers of the Institute of Chemistry of Ireland for 1960-61 are: *President*, Mr F. T. Riley; *Vice-President*, Mr M. J. Cranley, *Fellow*; *Immediate Past President*, Mr D. O'Tuama; *Hon. Treasurer*, Dr J. E. Gowan, *Associate*; and *Hon. Secretary*, Mr B. T. Foreman.

Amalgamation of the Institute of Physics and the Physical Society.—On 17 May the Institute of Physics and the Physical Society were formally amalgamated under the name of 'The Institute of Physics and the Physical Society.' The first *President* of the new body is Sir John Cockcroft, O.M., F.R.S.; the *Vice-Presidents*, Professor R. W. Ditchburn, Drs W. H. Taylor and J. Topping and Dr A. J. Philpot; *Hon. Secretary*, Dr C. G. Wynne; *Hon. Treasurer*, Dr J. Taylor. Sir George Thomson, F.R.S., and Mr J. A. Ratcliffe, Presidents of the two former societies, are members of the new Council.

The registered offices of the new body are at 47 Belgrave Square, S.W.1, and the executive officers are: Dr H. R. Lang, *Secretary*; Dr A. C. Stickland, *Editor and Deputy Secretary*; and Mr N. Clarke, *Deputy Secretary*.

Library of the Royal Institution.—The Managers of the Royal Institution wish it to be known that the Institution's Library is open for purposes of study to persons who are not members of the Institution. Admission to the Library is by means of a Reader's Ticket, for which no charge is made. Holders of such

tickets may use the Library for reference purposes only; they are not entitled to borrow books.

Application for a Reader's Ticket should be made on a form obtainable from the Secretary. Applicants, who must be over 18 years of age, will need to be sponsored by a responsible person to whom he is personally known.

Information about the Library and its contents may be obtained from the Secretary or Librarian of the Royal Institution, 21 Albemarle Street, London, W.1.

MEETINGS AND EXHIBITIONS

Castner Memorial Lecture.—The 6th Castner Memorial Lecture will be given by Dr W. J. Kroll of Oregon on 'The Fusion Electrolysis of Titanium' on 7 October in Glasgow. Further details may be obtained from the Society of Chemical Industry, 14 Belgrave Square, London, S.W.1.

Short Course for Chemistry Teachers.—During the Easter vacation the Chemistry and Biology Department of the South-East Essex Technical College and School of Art, Dagenham, held a short course for chemistry teachers. The main theme of the lectures was 'Molecular Structure' and the topics covered included resonance, molecular orbital theory, the carbon atom, the benzene ring and inorganic systems. Laboratory courses were also organized.

The director of the course was Mr J. Ratcliffe, and visiting lecturers included Professor E. D. Hughes, F.R.S., and Mr E. H. Coulson.

Protection of Gas Plant from Corrosion.—A joint symposium on The Protection of Gas Plant and Equipment from Corrosion is being arranged by the Institution of Gas Engineers and the Society of Chemical Industry and will take place at the College of Advanced Technology, Birmingham, on 22 and 23 September. A fee of 3 guineas will be charged (2 guineas to members of either society) and will entitle participants to advance copies of the papers to be presented. Further details and registration forms may be obtained from the Symposium Secretary, Department of Chemistry, College of Advanced Technology, Costa Green, Birmingham 4.

Laboratory Apparatus and Materials.—An exhibition of laboratory apparatus and materials will take place at the Royal Horticultural Society's New Hall, Westminster, from 20 to 23 June. Lectures on related subjects will be given during the course of the exhibition and include 'The Labelled Pool Technique in Biology' by F. P. W. Winteringham; 'Indicators' by Professor R. Belcher; 'Ion-Exchange Techniques' by Dr J. E. Salmon; 'Polarography in the Food and Beverage Industries' by J. Hetman; 'Rheology' by Dr G. W. Scott-Blair; 'Small-Scale Manipulation' by M. A. Fill; and 'Clinical Biochemistry' by Professor E. J. King. Tickets and further information may be obtained from U.T.P. Exhibitions Ltd, 9 Gough Square, Fleet Street, London, E.C.4.

Exhibition of Scientific Instruments.—An Exhibition of scientific instruments of importance in the field of automatic control in the chemical and allied industries will be held on Thursday, 30 June and Friday, 1 July in the Theatre Hall adjoining the new buildings of the Technical College, Birkenhead. The Exhibition will be open from 10 a.m. to 8 p.m.

About 35 firms will exhibit, the equipment ranging from simple electronic and pneumatic devices to computers.

Enquiries should be addressed to Dr J. Rose at the College. (This announcement cancels the incorrect note that appeared last month, p. 195.)

Non-Destructive Testing.—A joint summer meeting on Non-Destructive Testing is being arranged for 22-24 September by the Non-Destructive Testing Group of the Institute of Physics and the Physical Society, the Society of Non-Destructive Examination and the Non-Destructive Testing Society of Great Britain.

The meeting will take place in Cheltenham, and further details may be obtained from Mr I. M. Barnes, Materials Laboratory, de Havilland Propellers Ltd, Hatfield, Herts.

Polymers.—The Plastics and Polymers Group of the Society of Chemical Industry is organizing a symposium on High Temperature Resistance and Thermal Degradation of Polymers for 21, 22 and 23 September. The sessions will be held in the William Beveridge Hall, Senate House, University of London, and the Assembly Hall of the Institute of Education.

The fee for the Symposium is £4 10s. (£2 to members of the S.C.I.). A Symposium Dinner will be held on the evening of 22 September, tickets 50s. each. Further particulars may be obtained from the Assistant Secretary, S.C.I. (Plastics and Polymers Group), 14 Belgrave Square, London, S.W.1.

British Society of Rheology.—The Society will hold a meeting on the rheology of polymers at Swansea on 8, 9 and 10 September. Further details may be obtained from Dr M. F. Culpin, 8 The Broadway, Pontypool, Monmouthshire, S. Wales.

NEW AND RECENT PUBLICATIONS

Patents Abstracts Service.—With effect from January 1960 the titles of the Patents Abstracts issued by the Technical Information Company have been altered, as follows: the Patents Abstracts Journal has become *British Patents Abstracts* (£32 per annum); the German Patents Gazette is now *German Patents Abstracts*

(£32 per annum); the Russian Patents Gazette has been renamed *Russian Patents Abstracts* (£32 per annum). In addition Computer Bibliography has been renamed *Computer Abstracts* (£25 4s. per annum). Of these, the Russian patent abstracts are probably the most valuable, since the Russian patent literature is not so generally accessible. Over 500 patents per month are abstracted and those relating to Chemistry and Chemical Engineering are published as a separate section. The publishers will also provide photocopies of Russian Patent Specifications and translations into English.

Computer Abstracts provides abstracts of the patent and scientific literature relating to computers and accessories; each issue also contains an insert entitled *Computer News*.

In each of the publications the abstracts, although short, are sufficient to indicate to the reader whether the literature in question is likely to be of interest. Enquiries should be addressed to the Technical Information Company, Chancery House, Chancery Lane, London, W.C.2.

U.S.S.R. Patents and Inventions.—This is a translation into English of the Russian Journal *Biulleten' Izobretenii* (*Oxford*: *Pergamon Press Ltd*, 1959. Annual subscription, £50). It is published monthly and in addition to Official Notices contains classified abridgements of Patents and Authors' certificates. The Abstracts are well produced but the reproduction seems to be by photolithographic process and the print is somewhat small. The Abstracts will be of importance to those who desire to keep in touch with technical developments in Russia.

J. G. FIFE

Institute of Seaweed Research.—The Annual Report of the Institute for 1959 records further uses for seaweed constituents and extracts from various parts of the world. There has been a notable expansion of the seaweed industry, particularly in Ireland. The production of seaweed meal has approximately doubled, and prices are declining. Scottish production has declined. In Japan a mixture of sodium alginate and glucose in saline is used as a blood extender under the name Alginon. A major development, however, has been the demonstration that an extract of *Chondrus crispus* inhibits the formation of peptic ulcers. The large-scale production of mannitol from seaweed has been reported from France; this follows in the wake of the demand created by the synthetic product. With a capacity of 1 ton a day, a very pure product is obtained, valued at about £130,000 per annum.

Professor S. Peat, F.R.S., has joined the Scientific Advisory Committee, and Dr D. D. Pratt, C.B.E., who has been an assessor since the formation of the Institute of Seaweed Research in 1944, has resigned from the Board.

Toxic Substances in Factory Atmosphere.—This is the title of a new booklet, published by the Ministry of Labour, in a series intended to give information and advice about questions of safety, health and welfare in industry, and deals with the protection of workers against the inhalation of dusts or fumes or other impurities likely to be injurious. The booklet, No. 8 in the New Series of Safety, Health and Welfare Booklets, is obtainable from H.M.S.O., price 1*s*.

Approved Names.—The General Medical Council has issued a supplementary list of Approved Names dated May, 1960. The list is available from the Secretary, British Pharmacopoeia Commission, General Medical Council Office, 44 Hallam Street, London, W.1.

New Radiochemicals Laboratories.—Sir Cyril Hinshelwood, P.R.S., recently opened two new laboratories, costing £278,000, at the Radiochemical Centre of the U.K.A.E.A. at Amersham. These laboratories have been built to meet the growing demand for radioactive products and are part of a general development programme at Amersham. Since 1949 the number and value of consignments from the Centre have increased ten-fold. The total number of deliveries last year was 35,000, of value £1¼m.

The new laboratories are to be called the Organic and the Alpha laboratories. The Organic laboratory is concerned with chemical and biological work with the isotopes carbon-14 and hydrogen-3. Radium and other naturally-occurring radio-elements will be handled in the Alpha laboratory.

Visitors to the U.K.—

Australia. Dr J. Griffiths Davies, Division of Tropical Pastures, C.S.I.R.O., will be in the U.K. until 30 October. He will attend the International Grassland Congress and visit institutions in Europe concerned with the growing of pastures.

Professor P. R. McMahon, University of New South Wales, Dr D. S. Taylor, Division of Textile Industry, and Dr F. W. G. White, Chairman, C.S.I.R.O., will attend the International Wool Textile Research Conference.

Other visitors who will be in this country during July include: Professor H. Christensen, University of Michigan (10-16); J. Ashmore, Indiana University (10-17); A. Wettstein and F. Gross, CIBA Ltd, Basle (14-17); Sir Macfarlane Burnet, Walter & Eliza Hall Institute for Medical Research, Melbourne (16-27); Professor W. A. Engelhardt, U.S.S.R. Academy of Sciences, Moscow (17-27); Professor G. de Hevesy, Stockholm (17-27); Professor C. H. Best, Charles H. Best Institute, Toronto (17-28); Sir John Eccles, Australian National University, Canberra (18-29); Professor C. H. Li, Berkeley, Cal. (26 July-3 August).

Obituary

Erich Boehm. *B.* 27.4.1898. *Ed.* Fichte Gymnasium and Kaiser Friedrich Gymnasium, Berlin; University of Berlin, under Professor Sabalitschka, 1919–24; Robert Koch Institute, Berlin, 1925–26, studying uses of 'Nipa' esters as preservatives. Dr. Phil. His first post was as chemist with a food manufacturing firm in Berlin, of which he became a director. With Sabalitschka he discovered the antioxidant activity of the gallic acid esters. Later he filled a number of appointments in Germany, the last being director of research and production, Julius Penner A.G., and consultant chemist to I.G. Farbenindustrie. He came to this country in 1939 and in conjunction with the late Mr P. Samuelson and Mr A. H. Samuelson, essential oil importers, formed the company of Nipa Laboratories Ltd, Cardiff, with Dr Boehm as managing director; he held that position for the rest of his life. In 1942 he discovered the antibacterial activity of certain ethers of ethylene glycol. In 1944 he was also appointed scientific and technical adviser to Graesser Salicylates Ltd. The whole of his working life was devoted to preservatives, antioxidants and antiseptics, and his reputation and authority in this field received international recognition with his appointment to the Joint FAO/WHO Commission set up to consider the addition of chemical additives to foods in 1958. He published many papers and held several patents. He was a good business man and a capable administrator. 'He combined rare intellectual qualities with the integrity, charm and kindness of a true gentleman. He was always warmly interested in people as individuals, regardless of their social standing. He will be remembered by all who met him, but those who were privileged to know him well and to work closely with him will never forget him.' (*F.* 1946). *D.* 28.12.59.

William Henry Cadman. *B.* 12.8.1880. *Ed.* High School, Newcastle-under-Lyme, Staffs.; University College of North Wales, Bangor, 1899–1903. B.Sc. He was appointed in 1904 lecturer and examiner in chemistry, soil science and agricultural chemistry for the Ministries of Education and Agriculture of the Egyptian Government. During the First World War he served as an officer in the Special Brigade, R.E. (Gas Warfare) and as Assistant Chemical Adviser, Egyptian Expeditionary Force. He was awarded the M.B.E. (Mil.) in recognition of his services. After the cessation of hostilities, he returned to his former post, and in 1921 became professor of agricultural chemistry and physics at the Agricultural College, Giza, as well as research chemist (fumigation), Egyptian Ministry of Agriculture, and special lecturer in advanced organic chemistry, the School of Medicine, Cairo. He left Egypt in 1924 on his appointment as chief research chemist in Persia to the Anglo-Persian Oil Co. Ltd (now the British Petroleum Co. Ltd) and remained in the service of that company until his retirement. He was the author of scientific papers. (*A.* 1921, *F.* 1926.) D. 26.2.60.

William Caw. *B.* 6.4.1888. *Ed.* Glasgow and West of Scotland Technical College, 1906–09. He continued for a further two years at the College on research. He joined Joseph Watson & Sons Ltd, Leeds, as an assistant chemist in 1912. He served in H.M. Forces from 1914 until 1916, when he became a manager in the gun cotton section of H.M. Factory, Gretna. He entered the University of Glasgow in 1922 to undertake research and the following year was appointed manager of the Scottish Chemical Co. Ltd, Greenock. In 1931 he became production manager and technical adviser, Caddlehill Steam Laundry Co., Greenock, and in 1947 joined the Royal Ordnance Factory, Bishopton, as a factory safety inspector. He remained there until his retirement. (*A.* 1911, *F.* 1914.) *D.* 8.2.60.

Joseph Norman Edwardson. *B.* 30.1.05. *Ed.* St Mary's School, St Helens; Technical Schools (evening) St Helens, Widnes, Liverpool, 1920–24, 1926–28, 1935–38. He joined Pilkington Bros Ltd as a senior analyst in 1924. He remained with the firm for the rest of his life, becoming a works chemist in 1938, and later chief chemist. For a time he was a part-time lecturer in organic chemistry at the Gamble Institute, St Helens. (*A.* 1938.) *D.* 14.11.59.

Frederick John Hambly. *B.* 2.10.1868. *Ed.* Gloucester School of Science, 1882–85. He became chief laboratory assistant, in 1885, to G. Embrey, public analyst for the County of Gloucestershire. The following year he entered the Normal School of Science (now the Royal College of Science) London, as a student, and was appointed junior assistant demonstrator in chemistry and agricultural chemistry at the school in 1888. He left in 1889 to take up a post as senior demonstrator and assistant lecturer in chemistry at Dundee University College, and later became also lecturer in chemistry at the Dundee Technical Institute. In 1898 he went to Buckingham, Canada, to join the Electric Reduction Co. of Canada Ltd. The company was acquired by Albright & Wilson Ltd in 1902 who appointed him manager in Canada in 1914. He was promoted to managing director in 1926, and on the incorporation of the Canadian company in 1936 he became President and Treasurer. He retired in 1941. He took an active interest in the organization of Canadian chemists, served as President of the Chemical Institute of Canada in 1929, and was awarded the Canadian Medal of the Society of Chemical Industry in 1949. He was the author of a history of the Electric Reduction Company

and part-author of papers in the *J. chem. Soc.* His chief hobby was gardening. (*F.* 1892.) *D.* 2.2.60.

Ernest Wilfrid Jackson. *B.* 27.5.1879. *Ed.* Coatham Grammar School. He joined Pattinson and Stead, analytical and consulting chemists and metallurgists, as a pupil in 1896. Four years later he was appointed an assistant, later becoming chief assistant. He remained with the practice for the whole of his working life, eventually becoming senior partner and senior public analyst for Middlesbrough and the North Riding of Yorkshire. During the First World War, his services were utilized by the Admiralty, by the Ministry of Munitions, and by the Air Ministry. (*F.* 1919.) *D.* November, 1959.

Maurice Bevan Jarman. *B.* 21.9.06. *Ed.* Reading School; St John's College, Oxford, 1924–28; Eidgenössiche Technische Hochschule, Zürich, 1928–29. M.A., B.Sc. (Oxon.). He was appointed a research chemist at Imperial Chemical Industries Ltd in 1929. He remained with the company for the remainder of his life. After filling a number of positions as research chemist, shift manager, plant manager, section manager and works manager, he finally became associated with the recently formed Heavy Organic Chemicals Division of the company at Billingham. (*A.* 1931, *F.* 1946.) *D.* 4.1.60.

John Wardlaw Reid. *B.* 22.1.1895. *Ed.* Chelsea Polytechnic, 1918–22. His first appointment was as a chemical assistant in the general laboratory of the Gas Light & Coke Co. Ltd in 1922. He joined the Anglo-Iranian Oil Co. Ltd (now the British Petroleum Co. Ltd) in 1927 and remained in Iran until 1946, when he was transferred to the U.K. staff owing to ill-health. In 1952, he accepted a post with Griffin & Tatlock Ltd, and two years later became an inspector in this country for the Association Technique de l'Importation Charbonnière, of France. (*A.* 1926.) *D.* 9.2.60.

Geoffrey Lawrence Taylor. *B.* 20.9.33. *Ed.* Birkenhead Technical College, Liverpool College of Technology, 1949–52; Central College of Further Education, Carlett Park, 1952–54. He took a post as a laboratory assistant with Price's (Bromborough) Ltd in 1949. He served in the R.A.F., 1955–57, returning to his former post on his release. He moved to the Unilever Toilet Preparations Development Unit at Isleworth in 1958, where he remained until his untimely death. His sporting interests included badminton and cross-country running. He was also a mountaineer and held certificates of competence. (*A.* 1954.) *D.* 9.2.60.

Kenneth Turner. *B.* 10.10.07. *Ed.* Sheffield Secondary School; University of Sheffield, 1925–30. M.Sc., Ph.D. He became a junior research assistant at the British Cotton Industry Research Association in 1930, and was promoted to senior research assistant two years later. In 1940 he was seconded to the Clothing and Textiles Branch of the Ministry of Supply as a technical adviser. He left the Ministry in 1946 on his appointment as a section leader in the newly founded Fibre Evaluation Section, Dyehouse Department, Imperial Chemical Industries Ltd, Dyestuffs Division. A year later he joined Thomas Witter & Co. Ltd as assistant manager and technical adviser. He was promoted to Executive Director in 1954, a post which he held for the rest of his life. (*A.* 1942, *F.* 1945.) *D.* 11.1.60.

Frederick George Cannon Walker. *B.* 1883. *Ed.* School of Pharmacy, Pharmaceutical Society, 1902–04. He continued at the School of Pharmacy as a demonstrator in chemistry until 1905, when he was appointed assistant to the chief analyst in the Health Department of Shanghai Municipal Council, whom he later succeeded. He came to this country in 1915 to join H.M. Forces, becoming a major in the Special Brigade, Royal Engineers, and earning the M.C. He was later transferred to the Experimental Station, Porton. On the cessation of hostilities, he returned to his former post in Shanghai, where he remained until his retirement in 1935. He re-joined the Army in 1939 and served in France, but was evacuated the following year on account of age. He at once took up important chemical work in a civilian capacity, from which he retired at the end of 1945. (*A.* 1912, *F.* 1916.) *D.* 7.1.60.

John Howard Walker. *B.* 10.9.10. *Ed.* Appleby Grammar School; Queen's College, Oxford, 1929–33. B.A., B.Sc. He became a chemist at the Calico Printers' Association Ltd in 1933 until 1936, when he joined Lever Bros & Unilever Ltd. He was promoted to departmental manager in 1940 and two years later was seconded to the Ministry of Supply, undertaking duties in various parts of the country. He was released in 1945 and after a short period at Dowlais Oil Plant, was appointed shift manager at Van den Berghs & Jurgens Ltd, owned by Unilever; he left in 1948 to take an appointment as deputy chief chemist to the County Perfumery Co. Ltd and associated companies in the Beecham Group. In 1953 he was appointed chief chemist at the London Oil Corporation Ltd, a post which he held for the remainder of his life. His chief hobbies were gardening and golf. Whilst at Oxford he obtained a Blue in athletics. 'He endeared himself to his colleagues . . . by his very sincere efforts to lend a helping hand whenever he could.' (*A.* 1949, *F.* 1959.) *D.* 11.1.60.

Ernest Edmund Wells. *B.* 7.8.1889. *Ed.* Lincoln Technical School; Royal College of Science, London, 1912–17. B.Sc. He was appointed a chemist at Nobel's Explosives Co. Ltd (now Imperial Chemical

ndustries) Ltd in 1916 and took a similar post three ears later at the British Dyestuffs Corporation (now lso Imperial Chemical Industries Ltd). In 1922 he oined Rowntree & Co. Ltd where he remained until is retirement in 1954, by which time he had become a lirector. He was widely recognized in the cocoa and hocolate industry as a distinguished technologist. He erved on a number of scientific bodies and was a former Chairman of Council of the British Food Manufacturing ndustries Research Association. (*A.* 1916, *F.* 1922.) *D.* 26.1.60.

Sibyl Taite Widdows. *B.* 27.5.1876. *Ed.* Dulwich High School for Girls; Royal Holloway College (University of London), 1896–1900. B.Sc. She was appointed a demonstrator in chemistry at the London School of Medicine for Women (Royal Free Hospital) in 1901, was placed in joint charge of the Chemical Department in 1904, and became Head of the Department in 1935. She retired in 1942. Miss Widdows was a magnificent teacher and devoted her life at the London School of Medicine to teaching and to analytical work in connection with research. She was a pioneer among women at the School, and was much loved by students and colleagues. Her primary concern was the interests of her students and it was probably for this reason that she did not make any notable contributions to the advancement of chemistry by research. (*F.* 1918.) *D.* 4.1.60.

CORRESPONDENCE

New Grade of Membership

SIR,—The recent Council statement concerning licentiateship and affiliated membership raises many important issues, not all of which seem to be fully covered therein. The foremost point for consideration surely is what the function of the Institute should really be. Should it serve the profession of chemistry or should it serve all workers in the chemical field; and if the latter how far does 'all' extend? Clearly if only professional chemists or aspirants to the chemical profession are to be catered for—as is the case at present—there will be no support for the new schemes.

If, however, it is agreed that a home should be provided for other workers within the chemical field, a line should be drawn most clearly as to who might at some time be accommodated and who should not be. It must be remembered that not the least important of the chemical ancillaries are the storekeepers, the cleaner and the messenger boy—yet we would suggest that these should not be included. The exclusion is not, however, based on their lack of academic attainment because it is not such attainment which makes a laboratory technician useful in the chemical profession. Quite on the contrary, it is the practical skill of the technician which is of use and we think that the tentative proposal to register assistants when they have attained the H.N.C. is therefore based on a fallacy. Such registration might come to indicate merely that the affiliates are in effect 'failed A.R.I.C.' (to some extent this is, of course, true also of the proposed L.R.I.C.)

Instead, we think, the Institute should set up tests for laboratory technicians in practical skills such as, for example, synthetic practical chemistry, use of analytical instruments, glass-blowing, electronic circuitry, and preparation of slides. By all means register those technicians as affiliates who pass the tests irrespective of academic certification—registration on this basis would indicate something positive and not merely a failure to reach a high academic level. The professional members of the Institute could then rely on such registered affiliates to follow experimental directions with high skill and without supervision and they would thus be left free to do their professional work, which may, to some extent, have to be neglected in other circumstances.

Moreover, registration on this basis would be in the real tradition of the Institute, which is recognized as maintaining a very high standard in its practical examinations.

JOY P. STERN
EDWARD S. STERN

61 Latimer Road,
Cropston,
Leicester.

THE REGISTER

NEW FELLOWS

(OH) BHATIA, Iqbal Singh, M.SC. (PANJ.), PH.D. (JOHNS H.)
(P) HARVEY, Douglas Graham, M.B.E., B.SC., PH.D. (LOND.)
(P) LONGUET-HIGGINS, Hugh Christopher, M.A., D.PHIL. (OXON.), F.R.S.
(F) O'CONNOR, Norman James, M.SC., PH.D. (N.U.I.)

ASSOCIATES ELECTED TO THE FELLOWSHIP

(P) BEBINGTON, Norman Sidney John
(P) BRACKLEY, Peter Gordon, B.SC. (LOND.)
(P) BRITTON, Hubert Greenslade, B.SC., PH.D. (LOND.), M.A., M.B., B.CHIR. (CANTAB.)
(E) BROOKES, Leonard Hazeland, D.C.M., B.SC. (LOND.)
(P) COOKSON, Martin Alan, B.SC., PH.D. (LOND.)
(P) DYER, Bernard Stephen, B.SC. (LOND.)
(H) EABORN, Colin, D.SC., PH.D. (WALES)
(O) FRENCH, Alan, B.SC. (LOND.)
(OF) GAUR, Jagdish Narain, M.SC. (AGRA), PH.D. (RAJ.)
(S) GIBBONS, George Cuthbert, B.SC., PH.D. (LOND.)
(P) GOOD, William, B.SC., PH.D. (GLAS.), M.I.BIOL.
(R) GORDON-WILLIAMS, Harold Malcolm, B.SC. (LOND.), A.R.C.S. F.T.I.
(P) GOULDSTONE, Peter Jacques, B.SC. (LOND.)
(D) HALE, Clifford William
(P) HAMILTON, Wilfred Douglas Bailie, B.SC., B.AGRIC. (BELF.), M.S. (RUTGERS)
(R) HOLLINGSHEAD, Reginald George William, M.A. (OXON.)
(P) HOYLE, Bernard Edwin, B.SC., PH.D. (LOND.), A.K.C.
(P) HUNT, Peter Gordon, B.SC. (LOND.)
(P) JEFFERIES, Jack Philip, B.SC. (LOND.)
(P) KENDALL, Frank Henry, B.SC., PH.D. (LOND.)
KHAN, Riaz Ahmed, M.SC. (ALIG.), PH.D. (LOND.)
(P) LEE, Walter Henry, B.SC., PH.D. (LOND.)
(Q) LEWIS, Fred

(N) MATHIESON, Alexander Robinson, M.SC. (DUNELM.), PH.D. (NOTT.)
(M) NICOL, Donald Laurence, B.SC., PH.D. (LOND.), A.M.I.CHEM.E., DIP.CHEM.ENG.
(OE) PADMANABHAN, Salpradan, B.A. (MADR.), M.SC. (B.H.U.)
RADCLIFF, Frank John, B.SC., PH.D. (SYD.)
(R) REES, Wilfred Thomas, M.SC. (WALES)
(R) RUMENS, Murray James, B.SC. (LOND.)
(OG) SINGH, Raghbir, B.SC. (PANJ.), M.SC. (LUCK.)
(X) SKINNER, John McPhail, B.SC., PH.D. (GLAS.)
SPRAGG, Walter Thomas
(O) SWEENEY, Herbert
(Q) TENCH, Henry Booth, B.SC. (MANC.), M.INST.S.P.
(C) TOMS, Ronald George, B.SC. (LOND.), A.M.INST.S.P.
(E) TOWNEND, John, B.SC. (LOND.)
WALKER, Prof. Deryck George, M.SC., PH.D. (LOND.)
(E) WIGHT, Thomas Waldie, B.SC., PH.D. (EDIN.)
(O) WILSON, James Matchett, M.SC. (BELF.)

NEW ASSOCIATES

(Q) ALLPORT, Dennis Charlton, M.SC., PH.D. (MANC.)
(P) AYRES, Peter James William
(P) BELL, Stephen William, B.SC., PH.D. (SHEFF.)
(P) BOWLING, Robert George, B.SC. (LOND.)
(OF) CHAUDHRY, Nanak Chand, B.PHARM. (PANJ.), PH.D. (LOND.)
(OG) CHIPALKATTI, Vasant Bhimrao, B.SC., B.SC. TECH. (BOM.), PH.D. (GLAS.), A.R.C.S.T.
(Q) CLARK, Eric Innes, B.SC. (DUNELM.)
(C) COLLIS, James Gordon, B.SC. (LIV.)
(A) FRASER, Gordon Alister, B.SC. (ABERD.)
(P) GILDERSON, Russell Eric, M.SC. (LOND.)
(C) GREEN, Trevor, B.SC., PH.D. (BIRM.)
(E) GROVE, Nigel Hunter, B.SC. (LIV.)
HABIB, Muhammad Saleem, M.SC. (PANJ.), PH.D. (LOND.)
(Y) HAYES, Maurice John, B.SC. (LEEDS)
(P) JACOBS, Stephen, B.SC. (LOND.)
(T) JENKINS, Charles Delme, PH.C., F.P.S.
(P) JONES, Peter Marshall, M.SC. (LOND.)
(J) KRUK-WANTUCH, Rudolf Jerzy Jozef, A.H.-W.C.
(D) LEVESON, Leon Livingstone, B.SC. (LOND.)
(C) LINES, John Greenland, M.SC. (BIRM.)
(D) MCCARTHY, Helen Mary, M.SC. (N.U.I.)
(Q) MERCER, Eric Ian, B.SC. (LIV.)
(OA) MORRIS, John Edward, B.SC. (LOND.)
(P) MULHOLLAND, Daniel Booth, M.SC., PH.D. (BELF.), A.M.I.CHEM.E.
(OA) ONG, Kim Chye, B.SC. (MALAYA)
(P) PATEL, Jagubhai Kikabhai, B.SC. (GUJAR.), PH.D. (LOND.)
PATRICK, Jean Mitchell, B.SC., PH.D. (GLAS.), A.R.C.S.T.
(O) PITT, George Albert Jordan, B.SC., PH.D. (LIV.)
RAHMAN, Mohammad Ataur, M.SC. (PANJ.), PH.D. (LOND.)
(OD) RANGE GOWDA, Dase Gowda, B.SC. (MYS.)
(Q) ROBINSON, Harry, B.SC. (MANC.), A.M.C.T.
(O) ROUGHTON, Charles Lyn, B.SC. (LIV.)
(C) SIDDIQUE, Qazi Mohammad, M.SC. (PANJ.), PH.D. (BIRM.)
(OA) SINGH, Surinder, B.SC., PH.D. (MALAYA)
(C) TAYLOR, Harold Trevor, B.SC., M.SC.TECH., PH.D. (MANC.)
(N) TURNER, Walter Albert, B.SC. (LOND.)
(P) WATT, Alan Boyce, B.SC. (LOND.), A.F.INST.PET.
(P) WHITLEY, Thomas John Bailey, B.SC. (GLAS.), M.SC. (LOND.)
(OJ) WICKREMASINGHE, Robert Louis, B.SC. (CEYL.), B.SC. (LOND.), PH.D. (SHEFF.)
(E) WILKINSON, Derrick Maurice, B.SC. (LOND.)
(P) WINTERNITZ, John, B.A. (OXON.)
(P) WOOD, Graham Charles, M.A., PH.D. (CANTAB.), A.I.M.

GRADUATE MEMBERS ELECTED TO THE ASSOCIATESHIP

(Y) ARKELL, Gloria Mary
(P) BARNES, Terence John, B.SC. (LOND.)
(L) BENTLEY, Arthur
(Q) BOWEN, Derrick, A.M.C.T.
(D) CLARIDGE, Arthur Ralph
(P) COLINESE, David Lewis
(O) COOK, Brian
(E) COOPER, Kenneth Graham
(O) DUNCAN, Arthur Henry
(C) EVANS, Kenneth Arthur
(P) GRAHAM, John Frederick
(Q) GRIFFIN, Michael
(P) HAWTHORNE, Brian James, B.SC. (LOND.)
(T) JONES, Robert Edmund
(O) LEIGH, Hugh Wallis
(U) MARPLES, Lewis, B.SC. (MANC.)
(D) MOSS, Michael
(K) MUNRO, John Duncan, A.R.C.S.T. (GLAS.)
(Q) NAYLOR, David Keith, M.SC. (VAN.), A.R.T.C.S.
(Q) NEWTON, John Roy, A.M.C.T., A.R.T.C.S.
(W) PEACE, James Brian, B.SC., PH.D. (LOND.)
(P) PERKINS, Norman Albert
(N) ROBINSON, Richard John
(Q) ROYLE, Norman Edward, A.R.T.C.S.
(M) RUDKIN, John, B.SC. (LEEDS), DIP.CHEM.ENG. (BIRM.)
(N) RYAN, William
(P) STEPHENS, John Charlton Hext
(C) STEWART, Iain McIntosh, A.H.-W.C.
(O) THOMPSON, Lionel Keith, A.H.-W.C.
(O) TINSLEY, Kenneth Raymond
(EE) WALLACE, Thomas Derek
(C) WARDLE, Bernard
(C) WARNER, Derek Raymond, A.C.T. (BIRM.)
(R) WILLIAMS, Roger Owen
(Y) WOOD, Geoffrey Albert, A.M.C.T.
(Q) WOOLF, Leslie
(O) WORTHINGTON, William John

NEW GRADUATE MEMBERS

(C) BAMFORD, Alec William Byron, B.SC., PH.D. (LOND.)
(P) BANKS, Geoffrey Lee, B.SC. (LOND.)
(C) BELTON, Neville Richard, B.SC. (BIRM.)
(P) DAVIES, Daniel Elwyn Palmer, B.SC. (LOND.)
(P) ELLWOOD, Derek Clifford, B.SC. (DUNELM.)
(K) FLECK, Adam, B.SC., M.B., CH.B. (GLAS.)
(P) FREEDMAN, Arnold Montague, B.SC. (LOND.)
(P) HANSON, James Ralph, B.A., B.SC. (OXON.)
(P) HOLDEN, John Cresswell, B.SC. (LEEDS)
(Q) HOLLAND, Brian William, B.SC. (LIV.)
(P) JOHNSTONE, Eric, M.A. (OXON.)
(P) PALMER, Derek Joseph, B.SC. (LOND.)
(P) PENTON, Graham John, B.SC. (LOND.), A.R.C.S.
(P) TALBERT, Francis James, B.SC. (LOND.)
(P) TURNER, Frank, B.SC. (LOND.)
(P) ZISSELL, Martin John, B.SC. (OXON.)

STUDENT ELECTED TO THE ASSOCIATESHIP

(P) VANNOEY, Ronald Charles, B.SC. (LOND.)

DEATHS

Fellows

(P) HEBBS, Lewis Goodin Spire. Died 14 May, 1960, age 55. *A.* 1935, *F.* 1946.
(P) LLOYD, John Alexander, B.SC. (LOND.), M.SC. (BIRM.), PH.D. (WÜRZBURG). Died 3 April, 1960, aged 81. *A.* 1901, *F.* 1905.

Associates

(K) HALL, Leslie Kenneth. Died 13 March, 1960, aged 47. *A.* 1951.
(T) HUGHES, Samuel Percy, O.B.E., M.SC. Died 11 May, 1960, aged 66. *A.* 1926.
(C) LAWRIE, Leslie Gordon. Died 4 June, 1959, aged 69. *A.* 1921.
(L) MACPHERSON, David Archibald Whyte. Died 19 May 1960, aged 49. *A.* 1960.
(Q) OEHLCKE, Robert Geoffrey. Died 25 March, 1960, aged 28. *A.* 1959.
(F) WHELAN, Peter. Died 12 April, 1960, aged 70. *A.* 1920.
(Q) WILLIS, George Ernest. Died 1 May, 1960, aged 47. *A.* 1939.

Student Member

(D) SHORT, David Richard Nelson. Died 1 March, 1960, aged 24.